ASSESSMENT OF ANTIBIOTIC USE IN CHILDREN BY THEIR PARENTS IN SAUDI ARABIA

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KEYWORDS

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Factor analysis
Perceptions
Psychosocial
Purposeful selection of covariates
Reliability
Socioeconomic status
Upper respiratory tract infections
Validity

ABSTRACT

Background: The intervention of antibiotics in the 1940's have led to significant reduction in mortality and morbidity rates worldwide. Since their introduction, antibiotics consumption has increased significantly. Some of this consumption is unjustified or inappropriate, such as using antibiotics to treat viral infections, which is most common in children.

This unjustified use of antibiotics may lead to substantial health implications putting both the community and the individual at risk. Some of these important implications are: the development of adverse drug effects, increasing the burden and cost of chronic diseases, and in rare cases antibiotics can cause severe and sometimes fatal allergic reactions known as anaphylaxis. The most important harmful effect associated with the use of antibiotics is the emergence of bacterial resistance, currently one of the most important growing public health issues worldwide.

In Saudi Arabia, although the rules indicate that antibiotics need a prescription to be dispendsed, reports have shown a lack of adherence to over-the-counter regulations on antibiotic dispensing. Thus, making the decision to use an antibiotic almost entirely in the hands of the patient or parent. Reports about the pattern of antibiotics use in Saudi Arabia are very limited and no reports are available about the consumption of antibiotics in Saudi children.

Several factors may be associated with the use of antibiotics, such as: demographic characteristics, health-related information, and other psychosocial aspects. It is essential to measure the parent-related aspects influencing their use of antibiotics in children in Saudi Arabia. To the extent of our knowledge, and from the extensive literature review, no valid and reliable measurement instrument is available to measure the factors we intend to measure.

This study aims to assess the factors influencing the parents' use of antibiotics in children in Saudi Arabia, via the development and validation of a measurement instrument directed to measure the factors influencing the use of antibiotics on a population-based level.

Methods: The study was conducted on 2 stages: (1) instrument development and validation, and (2) discovering the prevalence of antibiotic use in Saudi children and what factors are influencing parents to this behavior.

For the first part of the instrument development, the Delphi technique was used to conduct a brain storming process within a group of experts from Saudi Arabia and Australia until consensus was reached independently about the items in the instrument. Then, cross-sectional study was conducted to perform using 238 parents of children younger than 12 years old in primary schools in the Eastern Province of Saudi Arabia from March to April 2012, face validity and preliminary validation was achieved at this stage.

Finally another cross-sectional study took place in primary schools parental meetings in the Eastern Province of Saudi Arabia from September 2012 to January 2013, where 1104 parents of children younger than 12 years old were included. Construct validation, convergent and divergent validation were achieved at this stage. Then, the prevalence of antibiotic use in children in Saudi Arabia was calculated. And the factors influencing the parental use of antibiotics in children were discovered in the Saudi context.

Results: The instrument was developed with the help of experts in the field in an iterative process until consensus was reached to 58 questions (including demographics), making the instrument content valid. Then, the instrument was translated to Arabic by adapting Brislin's method of translation. Face validity was confirmed in the pilot study, where the instrument appeared to be clear and un-ambiguous to the sample population.

The instrument's construct validity was assessed using Factor Analysis, Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA). Six factors were produced from the EFA while only five were confirmed in the CFA with good fit [GFI= 0.915, RMSEA= 0.047, the raw χ^2= 1470.334, and χ^2/df= 3.484 with p-value < 0.0001]. Constructs in the model include: Knowledge and Beliefs, Behaviours, Sources of information, Adherence, and Awareness about antibiotics resistance. The instrument was shown to have good internal consistency using Cronbach's alpha.

Convergent validity was determined when the Average Variance Extracted (AVE) of

each construct was higher than its correlation with other constructs. Discriminant validity was determined when the Maximum Shared Variance (MSV) and the Average Shared Squared Variance (ASV), both were lower than the Average Variance Extracted (AVE) for all of the constructs in the scale.

Data was collected using the PAPA instrument to: (1) Assess the variables influencing the psychosocial scales in the instrument using General linear models, where it was found that for all scales, fathers scored lower than mothers, and higher income parents scored higher than lower income ones; and (2) Discover the factors influencing the parental use of antibiotics in their children using ordinal logistic regression models. From this study it was found that with the increase in frequency of cold episodes in children, the number of antibiotic use increases significantly. Also, parents with higher scores in knowledge and beliefs, behaviour, and eagerness to seek health-related information appear to use antibiotics significantly less than parents with lower scores in these scales.

Conclusion: This is the first study that produced a valid and reliable instrument directed to measure the factors influencing the use of antibiotics. The PAPA instrument can be utilized in future research around the world to measure the factors influencing the use of antibiotics, and thus developing intervention strategies targeted to reduce the worldwide use of antibiotics.

This is the first population-based study in Saudi Arabia that measures the patterns of antibiotic use in children. The high association between the number of cold episodes and antibiotic use in children in the study suggest that there is a potential overuse of antibiotics in Saudi Arabia.

After measuring the parents' psychosocial aspects influencing their use of antibiotics, interventions can be directed to enhance the parent's knowledge and beliefs about antibiotics and its appropriate use, promote better behaviour regarding the judicious use of antibiotics, and increase people's eagerness to seek more health-related information to expand their health awareness.

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LIST OF ABBREVIATIONS

URTIs	Upper Respiratory Tract Infections
EFA	Exploratory Factor Analysis
CFA	Confirmatory Factor Analysis
SES	Socioeconomic Status
SR	Saudi Riyals
AUD	Australian Dollars
KFHU	King Fahad Hospital of the University
KSA	Kingdom of Saudi Arabia
IT	Information Technology
PAPA	Parental Perceptions on Antibiotics
MOH	Ministry of Health

PUBLICATIONS ON MATTERS RELEVANT TO THE THESIS

Publications during candidature

The following papers have been published during my candidature:

Alumran A, Hurst C, Hou X-Y: Antibiotics Overuse in Children with Upper Respiratory Tract Infections in Saudi Arabia: Risk Factors and Potential Interventions. *Clinical Medicine and Diagnostics* 2011, 1:8-16. – (**Available in Chapter 2)*

Alumran A, Hou X-Y, Hurst C: Validity and reliability of instruments designed to measure factors influencing the overuse of antibiotics. *Journal of Infection and Public Health* 2012, 5:221-232. – (**Available in Chapter 3)*

Alumran, A, Hou, X-Y, & Hurst, C. (2013). Assessing the overuse of antibiotics in children with URTIs in Saudi Arabia: Development of the parental perception on antibiotics scale (PAPA scale). *Journal of Epidemiology and Global Health*. doi: 10.1016/j.jegh.2012.11.005. – (**Available in Chapter 5)*

Alumran, A, Hou, X-Y, & Hurst, C. (2013). Assessing the overuse of antibiotics in children in Saudi Arabia: validation of the parental perception on antibiotics scale (PAPA scale). *Health and Quality of Life Outcomes, 11*(1), 39. – (**Available in Chapter 6)*

Alumran, A., Hou, X.-Y., Sun, J., Yousef, A. A., & Hurst, C. (2014). Assessing the construct validity and reliability of the parental perception on antibiotics (PAPA) scales. *BMC Public Health, 14*(73). *– (*Available in Chapter 7)*

Manuscripts submitted for publication during candidature

The following papers have been submitted for publication during my candidature:

Alumran, A, Hou, X-Y, Sun, J, Yousef, A, and Hurst, C. Assessing Factors Underlying Antibiotics Use in Children in Saudi Arabia: Modelling of the Parental Perception on Antibiotics (PAPA) Scales. Ready to be submitted. – (**Available in Chapter 8)*

Alumran, A, Hou, X-Y, Sun, J, Yousef, A, and Hurst, C. The Parental Use of Antibiotics in Children in Saudi Arabia. Ready to be submitted. – (**Available in Chapter 9)*

STATEMENT OF ORIGINAL AUTHORSHIP

The work contained in this thesis has not been previously submitted to meet requirements for an award at this or any other higher education institution. To the best of my knowledge and belief, the thesis contains no material previously published or written by another person except where due reference is made.

QUT Verified Signature

Signature:

Date: 02 June 2014

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Chapter 1: Introduction

The intervention of antibiotics has marked an important milestone in the history of medicine. The role of antibiotics in reducing the mortality and morbidity of diseases caused by bacteria is beyond any doubt. The challenge to the medical community is to maintain the effectiveness of antibiotics. When used inappropriately, antibiotics may lose its healing power as bacteria develop resistance. The objective of this study is to study factors influencing the use of antibiotics without proper indication, via the development of an instrument to measure these factors.

The first section in this chapter outlines the background and context of this research. Followed by, a description of the aim and objectives of this research and the research questions. The significance of the research is then described in the following section, followed by a definition of the terms used in this research. The final section outlines the remaining chapters of the thesis.

1.1 BACKGROUND

Despite the effectiveness of antibiotics in the treatment of numerous bacterial infections, it is often used inappropriately. This unjustified use of antibiotics is currently one of the major public health issues worldwide (Fahey, Stocks & Thomas, 1998; Flora, Scott, Jason & Jonathan, 2008; Grigoryan et al., 2007; Panagakou et al., 2011; Tenover, 2006). Although antibiotics are targeted to kill or inhibit the growth of bacteria and have no effect on viral agents (JETACAR, 1999), it is often inappropriately used to treat viral infections, such as most Upper Respiratory Tract Infections (URTIs) (West, 2002). Several problems are associated with the unjustified use of antibiotics, for instance: the development of bacterial

resistance, increasing the burden of chronic diseases, rising costs of health services, and the development of side effects (e.g. adverse gastrointestinal symptoms).

Unjustified use of antibiotic is found to be significantly frequent in children, especially when presenting with viral upper respiratory tract infection (URTIs) (Cebotarenco & Bush, 2008; Huang et al., 2007). And as children are at higher risk of viral diseases, it is fair to expect more use of antibiotics without proper indication. Although data about the trends in antibiotic use/misuse for adult patients attending primary health care centers in Saudi Arabia are available (El-Gilany, 2000), however, information regarding the antibiotic consumption in general in Saudi Arabia is very limited and there are no reports on the trends in antibiotic use among Saudi children (especially those with URTIs).

Most studies about antibiotic misuse are directed at the health professionals' level, and many intervention strategies are targeted to enhance doctor's judicious prescribing behavior (Gonzales, Steiner, Lum & Barrett, 1999; Little et al., 2005; Mainous, Hueston, Love, Evans & Finger, 2000; Sarkar & Gould, 2006; Snow et al., 2001; Spellberg, Guidos & Gilbert, 2008). However, other potential factors of antibiotics misuse are ignored (Bin Abdulhak et al., 2011). Thus, this study is directed to investigate the factors influencing the use of antibiotics without proper indication in a population-based level in Saudi Arabia.

Harmful Effects of the Unjustified Use of Antibiotics

The use of antibiotics causes several harmful effects on the community and on the individuals, these include: the development of adverse drug effects that can be preventable such as gastrointestinal effects (Al-Hassan, 2011; Irshaid, Al-Homrany, Hamdi, Adjepon-Yamoah & Mahfouz, 2004), increasing the burden of chronic diseases leading to an increase in the cost unnecessary spending in health services (Emanuele, 2010; Mora et al., 2002; West,

2002). Moreover, in rare cases antibiotics can cause severe, sometimes fatal, allergic reactions known as anaphylaxis (Farber, Ross & Stephens, 1954). In addition, in case of severe or overwhelming bacterial illness such as bacterial meningitis, a wrong type, dose, or rout of administration of antibiotics may result in suppressing the symptoms and giving misleading culture results but not treating the disease.

The most important harmful effect of using antibiotics is the development of bacterial resistance, which is currently one of the most important growing public health issues worldwide (Green, 2006; Sorkhou et al., 2002; Teng, Leong, Aljunid & Cheah, 2004). According to the Center of Disease Control and Prevention (2009), antibiotics resistance is mainly caused by the overuse of antibiotics in the community. Hence, antibiotics are considered to be inadvisable with the emergence of bacterial resistance (Green, 2006).

Bacterial resistance puts the community and individuals at risk (Mainous, Hueston, Davis & Pearson, 2003; Simasek & Blandino, 2007). Helms *et al.* (2002), concurs with these results where they found some bacterial strains are very resistant resulting in fatal outcomes. Several antibiotics are no longer effective in treating certain infections, such as ampicillin, amoxicillin-clavulanic acid and cotrimoxazole which are ineffective in treating infections caused by pathogenic E. coli and other related bacteria (Alshara, 2011). This emergence of bacterial resistance makes some infections harder to treat, thus rising the burden of disease and cost of health services in the community (Moellering, 1998).

The emergence of resistant bacterial strains have lead to an increase in the mortality and morbidity rates of previously treatable infectious diseases, such as: malaria, acute respiratory infections, diarrhea, and tuberculosis (Cohen, 1994; Kunin et al., 1987; World Health Organization, 2000, 2008).

Also, antibiotic misuse is highly related to the development of bacterial resistance

(Austin, Kristinsson & Anderson, 1999), such as failing to complete a course of antibiotic therapy, this might reflect the patient's/parent's low level of knowledge about antibiotics and their appropriate use (Al-Azzam, Al-Husein, Alzoubi, Masadeh & Al-Horani, 2007). Measuring the public's knowledge and awareness about antibiotics and their judicious use may ultimately reduce the problem of antibiotic resistance in the community, which can therefore protect the children from harmful and sometimes fatal bacterial infections.

Factors Contributing to the Overuse of Antibiotics

Several factors contribute to the unjustified use of antibiotics in the community; these include patient/parent-related factors and healthcare-provider-related factors. These factors include: cultural factors, behavioral characteristics, socio-economic status, and level of education (Braun & Fowles, 2000; Kozyrskyj et al., 2004; Teng et al., 2004). Health professionals usually blame their patients'/parents' pressure for their prescribing behavior (Peche're, 2001). Lack of health education is also one of the contributing factors discussed in the literature (Cebotarenco & Bush, 2008). Furthermore, self-medication is one of the most important aspects contributing to the unjustified use of antibiotics in many countries (Bi, Tong & Partonc, 2000; Sarahroodi, Arzi, Sawalha & Ashtarinezhad, 2010). It is essential to measure these factors in KSA to understand the causes of parental use of antibiotics in the community and therefore targeting the influencing factors to reduce this growing public health problem.

In many countries, dispensing of antibiotics is not overseen by strict government regulations, this is where the problem of over-the-counter antibiotic dispensing occures without a doctor's prescription. The government regulations in KSA state that antibiotics need a doctor's prescription to be dispensed (Bawazir, 1992; Saudi Food and Drug Authority, 2013). However, studies have shown that in KSA this policy is not adhered to by pharmacies (Al-Hassan, 2011; Bawazir, 1992; Bin Abdulhak et al., 2011). Many of the non-prescribed

antibiotics dispensed in these pharmacies are inappropriately given for viral infections, with and without the consumer's request (Bin Abdulhak et al., 2011). The lack of strict implementation of regulations on over-the-counter dispensing of antibiotics, suggests that the decision to use an antibiotic in children in KSA relies highly on their parents. Therefore, studying the factors influencing parental use of antibiotics is expected to lead to a reduction in the prevalence of antibiotic use in KSA.

Measurement of Psychosocial Factors

Psychosocial factors are important determinants of important phenomena in public health, such as antibiotics use. These factors can be measured using rating scales, which facilitate the measurement of construct that cannot be measured otherwise. Psychosocial measurement instruments needs to be valid and reliable to be effective and useful in health research. Reliability is assessed by evaluating whether the instrument can measure a consistent attribute while producing the same results every time (DeVon et al., 2007). Validity can be assessed by confirming its ability to measure what its intended to measure, comprising several types of validity such as: content validity, face validity, construct validity, and criterion validity (Ramaker, Marinus, Stiggelbout & Van Hilten, 2002).

To measure the psychosocial factors influencing the parental use of antibiotics in children, we need a valid and reliable instrument that can measure these factors. However, an extensive literature review was conducted and revealed that there is no valid and reliable instrument in the literature that can measure these psychosocial factors (Alumran et al., 2012). Therefore, the development and validation of this instrument are a huge part of this PhD study.

While naming the constructs in the instrument, we considered calling the 'adherence'

scale ‘compliance’ instead. Aronson (2007) discussed the difference between ‘compliance’ ‘adherence’, where compliance means to fill up or to complete an action and fulfill a promise, and adherence means to cling to, keep close, or remain constant. According to the Oxford English Dictionary, compliance is “The acting in accordance with, or the yielding to a desire, request, condition, direction, etc.; a consenting to act in conformity with; an acceding to; practical assent”, and adherence is to “Persistence in a practice or tenet; steady observance or maintenance”. The definition of adherence appropriately reflects on the patient’s need to achieve their goals in following strict therapeutic regimens. Therefore, ‘Adherence” was chosen to be the word representing the scale.

Healthcare in the Kingdom of Saudi Arabia

Kingdom of Saudi Arabia is considered a developing yet affluent country. The Ministry of Health (MOH) in KSA is the main provider of healthcare services. There are 251 hospitals in MOH and 34,450 beds (12.1 beds/ 10,000 people), 2109 primary healthcare center (Health statistical year book, 2011). Private sector has 130 hospitals with 13,298 beds, 198 private clinics, 2,185 private polyclinics; 6,373 private pharmacies with a rate of one pharmacy/4,453 people; 60% of the total health services in Saudi Arabia are within these services (Health statistical year book, 2011).

Other government bodies (comprising 10,948 beds), include: Ministry of Higher Education hospitals (teaching hospitals), including: King Abdulaziz university hospital in Riyadh, King Khalid university hospital in Riyadh, King Fahad university hospital in Khobar, King Abdulaziz university hospital in Jeddah; referral hospitals, including: King Faisal Specialist Hospital and Research Centre in Riyadh and Jeddah); Armed forces medical services; National Guard health affairs; Security forces medical services; Royal Commission

for Jubail and Yanbu health services; ARAMCO hospitals; school health units of the Ministry of Education; and the Red Crescent Society (Health statistical year book, 2011).

According to the Human Drug List produced in May 2013 (Saudi Food and Drug Authority, 2013), antibiotics in KSA should only be dispensed with a prescription. However, studies in KSA have revealed that pharmacies do not follow these regulation strictly (Bawazir, 1992; Bin Abdulhak et al., 2011). The behavior of over-the-counter medication, although prohibited by government regulations, but evidently present in Saudi Arabia. This behavior of over-the-counter medication leaves the decision of using antibiotics almost entirely to the patients/parents. Therefore, it is important to measure the use of antibiotics on a population-based level.

1.2 RESEARCH GAPS IN THIS TOPIC (FROM THE LITERATURE REVIEW)

Antibiotic use is harmful to the community and individuals; it causes the development of bacterial resistance, adverse gastrointestinal effects, and other risks associated with the use of antibiotics. Several factors are discovered in the literature to be associated with the use of antibiotics, such as: patient's/parent's pressure, self-medication and over-the-counter medication, socio-economic status, education levels, and lack of health education. No study was conducted in KSA to discover these influencing factors in a population-based level. Furthermore, several studies attempted to measure the pattern of antibiotic use in KSA, but none measured the patterns in children. There is a need to measure the pattern of antibiotic use in Saudi children, and to discover the factors influencing this use in the Saudi community.

A valid and reliable instrument needs to be available to discover the factors influencing the use of antibiotics. Existing scales in the literature were reviewed thoroughly to find a valid and reliable instrument that measures the variables we intend to measure. Scales

reviewed were either direct to patients/parents, doctors, or both. The extensive literature review (Alumran et al., 2012) assessed the development, implementation and validation of these existing scales. Some of the published scales attempted to assess content and face validity, but none mentioned full validation process of their instrument. Therefore, there is a need to develop a valid and reliable instrument that measures the factors influencing the use of antibiotics in order to discover these factors in the Saudi community, especially in children.

1.3 RESEARCH AIM

Is to provide baseline epidemiological data on the use of antibiotics in children in KSA

1.4 OBJECTIVES

1- To develop and validate a framework measuring the psychosocial factors associated with the use of antibiotics
2- To utilize this framework to identify the factors associated with parental use of antibiotic in children in Saudi Arabia.
3- To make recommendations in regard to evidence-based policy solutions.

1.5 RESEARCH QUESTIONS

1- What are the items (variables) to be included in the framework (measurement instrument) measuring the psychosocial aspects related to the use of antibiotics?

2- Is the developed framework (instrument) valid and reliable to be used in this research and future research?

3- What are the influencing factors associated with the parents' use if antibiotics in children in Saudi Arabia?

4- How are the parent's psychosocial aspects related to their demographic information and to their children's health-related history?

5- What future recommendations (i.e. policy changes or intervention strategies) can be drown from the results presented in this study?

1.6 SIGNIFICANCE OF THIS RESEARCH

Previous unpublished study (abstract is in appendix A) found that antibiotics are the most utilized drug category in a main tertiary teaching hospital in the Eastern province of KSA accounting for 17% of the total drugs prescribed in the hospital (Figure 1.1). Also, antibiotics accounted for the most costly drug category utilized in the study period in KFHU (Figure 1.2). However, other than prescribed antibiotics, studies show that self-medication with antibiotics is an important issue in many countries and in Saudi Arabia specifically (Al-Azzam et al., 2007; Al-Bakri, Bustanji & Al-Motassem, 2005; Awad, Eltayeb, Matowe & Thalib, 2005; Bawazir, 1992; Sarahroodi et al., 2010).

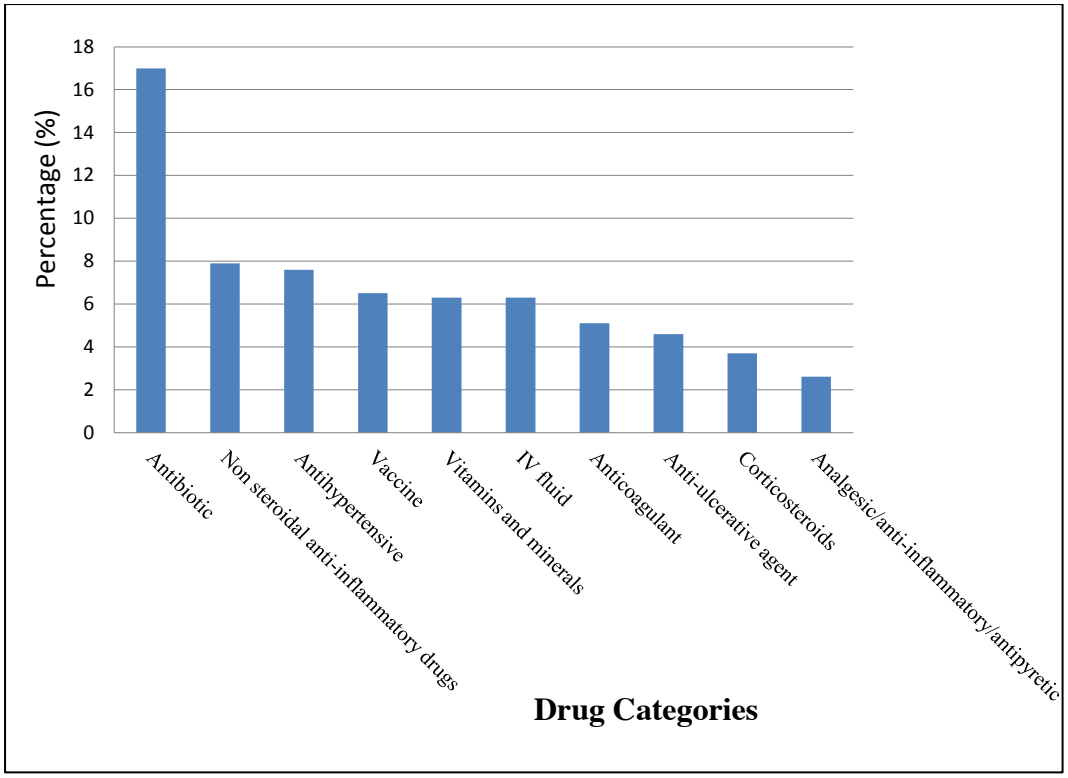

Figure 1.1 - The ten most frequent drug categories used in KFHU from 1st January to 30th June 2006

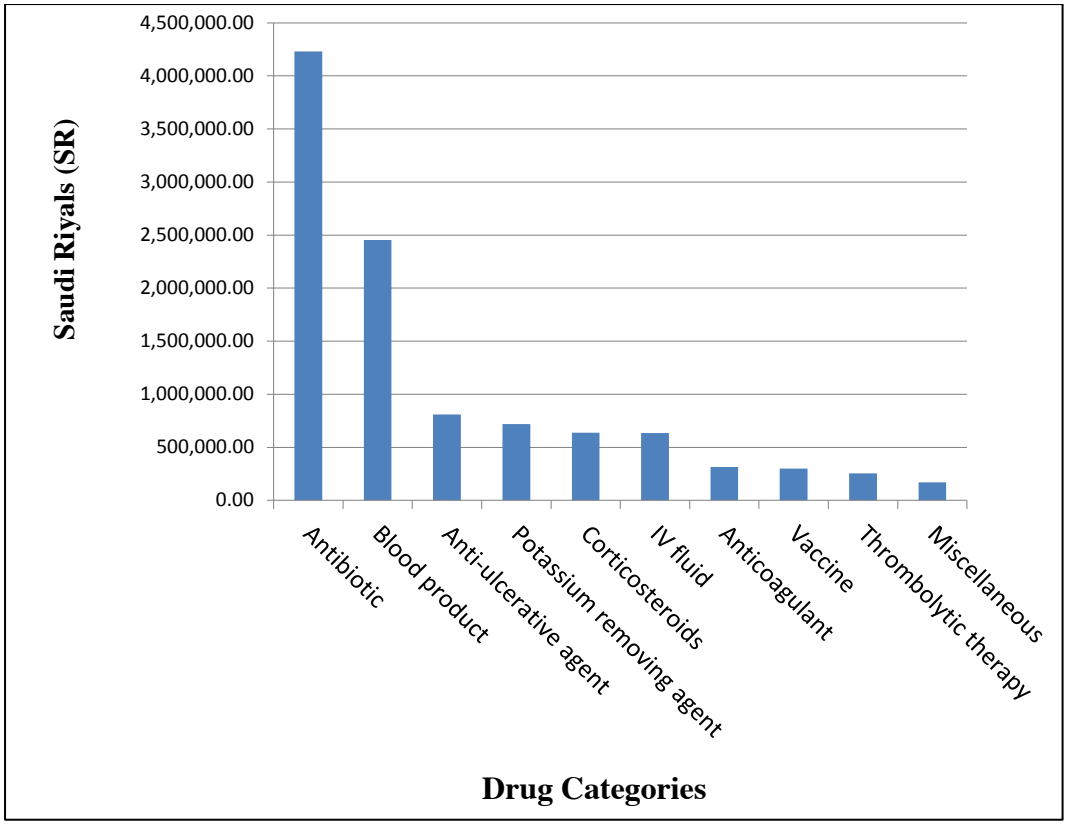

Figure 1.2 - The ten most costly drug categories at KFUH from 1st January to 30th June 2006

These findings emphasize the need to analyze the factors influencing this high utilization of antibiotics in Saudi Arabia. Parents' knowledge, behaviors, attitudes and beliefs are likely to compose some of the constructs influencing parents' decision to use antibiotics in children with URTIs in KSA. To measure such psychosocial constructs, a valid and reliable instrument needs to be administered to the intended population: parents/guardians. It is clear from the literature that no valid and reliable instrument has been previously developed to measure these factors (Alumran et al., 2012). This study aims to develop a valid and reliable instrument directed at parents to measure the factors contributing to the growing public health issue of antibiotics use in KSA, especially in children with URTIs, and then target these factors for an intervention policy.

1.7 DEFINITION OF TERMS

Children – boys and girls from the age of 0 until 16 years old

Antibiotics – antibacterial agents targeted to kill or inhibit the growth of bacteria

Overuse – the inappropriate use any drug or the excessive use

Bacterial resistance – when bacteria and other microorganism develop the ability to resist the effect of an antibiotic; which was once effective on that same bacteria or microorganism.

Upper respiratory tract infections – group of illnesses presenting with runny nose, sore throat and coughing which are almost invariably viral in origin; either the common cold or Influenza.

Psychosocial instrument – measurement instruments targeted to measure psychosocial factors that are otherwise unobservable

Instrument validation – evaluating whether the instrument measures what it is intended to measure

Reliability – The ability of an instrument of measuring a consistent attribute

1.8 CONTENTS AND STRUCTURE OF THE THESIS

This thesis is presented in the 'Thesis by Publication' style and contains of two independent literature reviews, and five original articles designed to stand alone. Chapter 2 and 3 include the published literature reviews, one is related to antibiotics and their inappropriate use to treat viral upper respiratory tract infections, and the other one is about the measurement instruments available in the literature that can measure the factors influencing the use of antibiotics.

Chapter 4 describes an overview of the methods that were used in this PhD study; details on methodological techniques are available in the individual articles.

Since there was no available instrument directed to measure the factors we intend to measure, the Parental Perceptions on Antibiotics (PAPA) instrument was developed and translated as the first original contribution of this PhD study. The development and translation processes are available in Chapter 5; this article is published in the *Journal of Epidemiology and Global Health*.

Chapter 6 and 7 show the validation of the developed instrument. Chapter 6 shows the pilot study and the preliminary validation of the PAPA instrument, the article is published in the *Journal of Health and Quality of life Outcomes*. Chapter 6 shows the rest of the validation process of the PAPA instrument, this article is submitted for publication in *BMC Public Health*.

The factors contributing to the problem of antibiotic use in Saudi Arabia were then analysed using the developed and validated instrument on a cross-section of the Saudi

population. Chapters 8 and 9 show the details of these studies. Two articles were produced from these studies, and both are ready for publication.

Chapter 10 discusses the summary of the study findings across Chapters 5 to 9, followed by substantive discussion, recommendations for future research, limitations of this study, and conclusions.

Chapter 2: Literature Review (Part 1)

Title: Antibiotics Overuse in Children with Upper Respiratory Tract Infections in Saudi Arabia: Risk Factors and Potential Interventions

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Contribution of authors:

The candidate reviewed the literature and wrote the manuscript. All authors provided feedback and valuable input on the initial draft of the manuscript.

Summary and Implications

Antibiotics misuse/overuse is an important global public health issue that affects the community and the individual. Using antibiotics to treat children from upper respiratory tract infections is evidently inappropriate unless the infection was proven to be bacterial. This misuse of antibiotics, especially in children, will increase the risk of developing bacterial resistance, which emphasises on the need to discover the contributing factors to this overuse of antibiotics. Factors influencing the misuse/overuse of antibiotics in the literature include (1) psychosocial factors, such as: behaviours, beliefs, and attitudes (e.g., self-medication & over-the-counter medication), (2) parents pressure, often documented by doctors, (3)

demographic characteristics (e.g., socio-economic status, education levels) and (4) and lack of health education. Discovering the factors affecting the misuse/overuse of antibiotics in Saudi Arabia, whether they are patients'/parents'-related or doctors'-related could assist in the development and implementation of a well-designed methodological intervention protocol that can lead to a decrease in antibiotics use.

Interventions suggested in the literature may include: (1) health education campaigns, professional education as well as public awareness campaigns are evidently effective in the reduction of the unnecessary use of antibiotics in children with upper respiratory tract infections. (2) Doctor-patients interactions, where the patient/parent gets involved in the decision making process with the doctor. And/or (3) policy change, such as: implementing a new policy for delaying antibiotics prescription for 48 hours which will give the self-limiting conditions time to heal without the use of medications, however, this can be challenged by the notion that this policy may be dangerous in some serious bacterial diseases. Choosing the best intervention protocol relays on discovering the most influencing factor(s) associated with this overuse.

Inclusion criteria:

Studies about antibiotics and their inappropriate use especially to treat viral upper respiratory tract infections were reviewed.

Key words:

Antibiotics, Misuse, Overuse, Intervention Strategies, Children, Upper Respiratory Tract Infections, Saudi Arabia

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Statement of Contribution of Co-Authors for Thesis by Published Paper

The following is the format for the required declaration provided at the start of any thesis chapter which includes a co-authored publication.

The authors listed below have certified* that:

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2. they take public responsibility for their part of the publication, except for the responsible author who accepts overall responsibility for the publication;
3. there are no other authors of the publication according to these criteria;
4. potential conflicts of interest have been disclosed to (a) granting bodies, (b) the editor or publisher of journals or other publications, and (c) the head of the responsible academic unit, and
5. they agree to the use of the publication in the student's thesis and its publication on the QUT ePrints database consistent with any limitations set by publisher requirements.

In the case of this chapter:

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Contributor	Statement of contribution*
Arwa Alumran  30/10/2013	The candidate reviewed the literature and wrote the manuscript. All authors provided feedback and valuable input on the initial draft of the manuscript.
Xiang-Yu Hou	Provided feedback and valuable input on the initial draft of the manuscript.
Cameron Hurst	Provided feedback and valuable input on the initial draft of the manuscript.

Principal Supervisor Confirmation

I have sighted email or other correspondence from all Co-authors confirming their certifying authorship.

Xiang-Yu Hou		13/11/2013
Name	Signature	Date

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Antibiotics Overuse in Children with Upper Respiratory Tract Infections in Saudi Arabia: Risk Factors and Potential Interventions

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Abstract Background: Antibiotics misuse is currently one of the major public health issues worldwide. This misuse lead to the development of bacterial resistance, increasing the burden of chronic diseases, rising costs of health services, and the development of side effects. Several factors may influence this pattern of overuse. Objectives:This article will review the pertinent factors contributing to the overuse of antibiotics worldwide, and to assess the intervention strategies to limit this overuse. Methods: studies about antibiotics use in children were reviewed from several electronic databases, such as MEDLINE and Pubmed. Results: Factors contributing to the overuse of antibiotics could include psychosocial factors, such as behaviors and attitudes (e.g. self-medication, over-the-counter medication, or patients/parents pressure), and demographic factors, such as socio-economic status and education level. Several intervention strategies were reported to be effective in reducing the overuse of antibiotics, such as health education, doctor-patient communication, and policies change. Multifaceted interventions were found to be the most effective in reducing the antibiotics overuse.

Keywords Antibiotics, Misuse, Overuse, Intervention Strategies, Children, Upper Respiratory Tract Infections, Saudi Arabia

1. Introduction

Despite the effectiveness of antibiotics in the treatment of numerous bacterial infections, it is often used inappropriately. This misuse of antibiotics is currently one of the major public health issues worldwide (Fahey, Stocks, & Thomas, 1998; Flora, Scott, Jason, & Jonathan, 2008; Grigoryan, et al., 2007; Le, Ottosson, Nguyen, Kim, & Allebeck, 2011; Tenover, 2006). Although antibiotics are targeted to kill or inhibit the growth of bacteria and have no effect on viral agents (JETACAR, 1999), it is often inappropriately used to treat viral infections, such as most of Upper Respiratory Tract Infections (URTIs). Problems associated with the overuse of antibiotics include development of antibacterial resistance, increasing the burden of chronic diseases, raising costs of health services, and the development of side effects (e.g. adverse gastrointestinal effects).

Antibiotic misuse was found to be significantly frequent in children, especially when presenting with viral upper respiratory tract infections (URTIs) (Cebotarenco & Bush, 2007). El-Gilany(2000) studied the trends in antibiotic use/misuse for adult patients attending primary health care center and found that of all prescriptions for URTIs, approximately 87 percent contained antibiotics.

Several contributing factors are evidently associated with the overuse of antibiotics both at the patient's (or parents of children) level and doctor's level, namely: cultural factors, behavioral characteristics, socio-economic status, and level of education (Braun & Fowles, 2000; Kozyrskyj, et al., 2004; Teng, Leong, Aljunid, & Cheah, 2004). Furthermore, doctors usually relate their pattern of over prescribing to patients'/parents' pressure (Peche're, 2001). Also, lack of health education is one of the major contributing factors in the overuse of antibiotics (Cebotarenco & Bush, 2007). Self medication is a very important behavioural aspect that contributes to the misuse of antibiotics (Bi, Tong, & Partonc, 2000; Sarahroodi, Arzi, Sawalha, & Ashtarinezhad, 2010). This article is a review of the literature regarding the global overuse/misuse of antibiotics in children with upper respiratory tract infections. Factors influencing this behavior and interventions targeted to limit this phenomenon are also discussed in this review.

2. Materials and Methods

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Studies about antibiotics misuse were reviewed from several electronic databases, such as MEDLINE and Pubmed. A total of 72 worldwide articles were reviewed, countries included in this review are: Australia, the United States of America, Canada, the United Kingdom, some European countries, some Middle East countries (Saudi Arabia, Jordan, Kuwait, and Iran), some South American countries, some African countries, and some Asian countries.

3. Literature Review

3.1. Antibiotics Misuse

Antibiotics are chemical agents capable of either killing or inhibiting the growth of bacteria (JETACAR, 1999). Antibiotics have a major role in the treatment of bacterial infections, which have led to significant reduction in child morbidity and mortality rates worldwide (Teng, et al., 2004). However, since the introduction of antibiotics in 1941 (Waksman, 1947), antibiotics consumption has significantly increased around the world (Cebotarenco & Bush, 2007). Several researchers have studied this increasing consumption of antibiotics through the years and an increasing trend of inappropriate consumption has been demonstrated in a range of countries (Ahmed & Al-Saadi, 2005; Al-Faris & Al-Taweel, 1999; Irshaid, Al-Homrany, Hamdi, Adjepon-Yamoah, & Mahfouz, 2004; JETACAR, 1999; Mainous, Hueston, Davis, & Pearson, 2003; Simasek & Blandino, 2007; Simoes, et al., 2006).

Huang et al. (2007) believed that a considerable amount of antibiotics prescribed to children is inappropriate. This significant finding of the escalating antibiotic misuse especially in children is therefore considered one of the most important global public health issues. Ali & Ahmed (1995), found that antibiotics were the drugs most commonly prescribed by the primary care physicians for all age groups representing 40-63% of the total drug prescriptions in the Asir region, in southern Saudi Arabia. Similarly, Ahmed & Al-Saadi (2005) studied the prescribing patterns of 200 doctors in Saudi Arabia and found that the most frequent drug categories prescribed for all age groups were antibiotics. Thus, information from these resources emphasizes the need for continuing medical education on the physicians' rational prescribing behavior.

3.1.1. Upper Respiratory Tract Infections (URTIs)

Literature reports (Palmer & Bauchner, 1997; West, 2002) have shown that upper respiratory tract infections (URTIs) are the most common infectious diseases worldwide, including common cold, influenza, rhinorria, and bronchitis. URTIs were responsible for almost one-quarter of all encounters in a general practice evaluated in a Malaysian study (Teng, et al., 2004). Bhasin, Budden, Ketkar, & Pawar(2002) reported that URTIs are responsible for a large percentage of consultations in general practices, mostly in the case of neonates, infants and children. A study in the United Kingdom have been conducted to evaluate the prevalence of URTIs specifically in children, showed that the average number of common cold episodes occurring in each child annually is 3-8 times and some children (10-15%) have at least 12 episodes of common cold per year (West, 2002). It is argued that this increasing number of URTIs episodes in children is associated with attendance at day-care centers or nurseries (McCutcheon & Fitzgerald, 2001; Palmer & Bauchner, 1997; West, 2002). The public's knowledge in regard to URTIs in Saudi Arabia needs to be further investigated to measure its association with antibiotics overuse.

3.1.2. Inappropriate Antibiotic Use to Treat Viral URTIs

Although antibiotics therapy is considered appropriate for treating acute bacterial infections such as acute otitis media, rhino-sinusitis, and bacterial pharyngitis; it is proven to be inappropriate for treating bronchitis or viral URTIs (Hoa, et al., 2009; Skull, Ford-Jones, Kulin, Einarson, & Wang, 2000). Proper decision-making regarding the appropriate use of antibiotics is challenging and experience is needed to promote decision-making skills. Three criteria were documented by Bennet & Geme (1999) to promote decision-making process regarding antibiotics prescriptions: (1) antibiotics are not indicated at all (e.g. common cold and bronchitis), (2) using clinical criteria to justify the need for antibiotics (e.g. otitis media and sinusitis), or (3) diagnostic testing confirming the need for antibiotics (e.g. pharyngitis). Appropriate judgment can lead to an overall decrease in antibiotics use and ultimately in reducing antibiotics resistance (Bennet & Geme, 1999). Physicians' decision-making skills in Saudi Arabia need to be investigated to find its association with the over prescription of antibiotics.

URTIs are usually viral in nature and using antibiotics to treat them is considered inappropriate, except for cases where bacterial infections are obvious. URTIs are usually self-limiting and resolve in the same amount of time regardless of antibiotic consumption(Wutzke, et al., 2007). A meta-analysis by Al-Faris & Al Taweel(1999) and several systematic reviews(Arroll & Kenealy, 2005; Fahey, et al., 1998) concluded that there is no evidence to support the use of antibiotic treatment for acute bronchitis. Despite the proven ineffectiveness of antibiotics in the treatment of viral URTIs, research around the world shows a high prevalence of antibiotics used to treat URTIs (Table.1). In a study conducted in Malaysia by Teng et al. (2004), antibiotics were prescribed more frequently in patients with URTIs (68.4%) than those without URTIs. Similarly, The Saudi literature revealed that the most frequent diagnosis in all age groups for which antibacterial drugs were prescribed was URTI (43.8%) (Irshaid, et al., 2004). Also, El-Gilany (2000) found consistent results when they assessed the pattern of drug prescriptions in all age groups attending primary health care centers in Saudi Arabia; one-third of the prescriptions analyzed in their study were for URTIs and 87% of those were prescribed antibiotics. Concurrent results were found in

Taiwan where antibiotics were prescribed in 31.3% of patients with common cold (Chang, Shiu, & Chen, 2001). Belongia et al. (2002) revealed that, of those with non bacterial infections, 60% of the adults and 46% of the children were prescribed antibiotics. Also, in a recent study in Vietnam Hoa, et al. (2011) found that 62% of the study children were given antibiotics and 63% of antibiotic courses were used for mild ARIs.These worldwide figures highlight the importance of exploring the factors affecting the excessive use of antibiotics to treat viral URTIs.

Table 1. Worldwide Figures Describing the Overuse of Antibiotics.

Study	Subjects	% Prescribed antibiotics	Country
(Ali & Ahmed, 1995)	89 primary health care physicians	40-63% of all diagnoses	Saudi Arabia
(Belongia, et al., 2002)	405 adults and 275 parents of children	60% of adults and 46% of children for non bacterial infections	United States of America
(Chang, et al., 2001)	190,971 patients visits throughout the study period.	31.3% of common cold episodes	Taiwan
(El-Gilany, 2000)	40 primary health care centers	87% of URTIs	Saudi Arabia
(Irshaid, et al., 2004)	3796 prescriptions	43.8% of URTIs	Saudi Arabia
(Hoa, et al., 2009)	Doctors	79% prescribed antibitoics for common cold	Vietnam
(Hoa, et al., 2011)	Children	63% for mild URTIs	Vietnam
(Teng, et al., 2004)	150 clinics 3481 complete forms	68.4% of URTIs	Malaysia
(Nyquist, Gonzales, Steiner, &Sande, 1998)	531 pediatric office visits	44% of patients with common colds, 46% with URIs, and 75% with bronchitis.	United States of America

Frequent prescribing of antibiotics to children with URTIs has become a major public health issue (Huang, et al., 2007). According to Nyquist, Gonzales, Steiner, &Sande (1998), in the United States 44% of children with common cold are given different types of antibiotics. Despite the fact that URTIs are caused by various respiratory viruses, most commonly rhinovirus (Simasek & Blandino, 2007; Simoes, et al., 2006; West, 2002), they are often mismanaged and treated with antibiotics even when bacterial complications (e.g., pneumonia, bacterial sinusitis) are not present(Cebotarenco & Bush, 2007; Green, 2006; Wutzke, et al., 2007). In fact, evidence from previous reviews suggests that most URTIs in children are self-limiting and require symptomatic treatment alone. Antibiotic treatment is more likely to be harmful than beneficial (Fahey, et al., 1998).To minimize the harmful effect of antibiotics, it is important to raise people's awareness regarding the use and misuse of antibiotics and its implications, especially when used to treat URTIs. Nevertheless, data found in Saudi medical literature is mainly about antibiotic misuse in adults, it is therefore important to fill the gap in knowledge in regards to antibiotic misuse in children, by studying the utilization of antibiotics in children with URTIs in Saudi Arabia.

3.2. Problems Associated with Unnecessary Exposure to Antibiotics

The excessive use of antibiotics exposes the community to several public health issues, some of which are:

3.2.1. Antimicrobial Resistance

Although antibiotics have a significant role in the reduction of morbidity and mortality rates worldwide, their increasing inappropriate consumption leads to the development of bacterial resistant strains. Such resistance to antibiotics is likely to lead to reduction in the effectiveness of many antibiotics (Sorkhou, et al., 2002). Moreover, antimicrobial resistance places both populations and individuals at risk (JETACAR, 1999; Mainous, et al., 2003; Simasek & Blandino, 2007). Green (2006) asserts that antibiotics are becoming inadvisable with the emergence of antibacterial resistance. One of the main reasons that encourage the development of antibiotic resistance is the inappropriate use of antibiotics to treat viral URTIs (Teng, et al., 2004). Individuals' risk from unnecessary consumption of antibiotics, especially to treat URTIs, should be emphasized.

Numerous studies confirmed that high proportions of young children get URTIs from childcare attendance, and most of these children receive antibiotics to treat their URTIs; thus indirectly leading to the development of bacterial resistance in the community (Arnold & Straus, 2005; Nyquist, et al., 1998). Skull et al. (2000) and Kozyrskyj et al.(2004) concur that child-care center attendance is an indirect risk factor for developing bacterial resistance. Promoting the judicious use of antibiotics by parents could protect children from bacterial resistance.

3.2.2. Cost

The cost of health services will be significantly elevated ifthe problem of antibiotic misuse persists(Al-Faris & Al-Taweel, 1999; Foster & Sabella, 2011; JETACAR, 1999; Sarahroodi, et al., 2010).For example, according to West (2002), $2 billion are spent each year in USA on over-the-counter preparations to treat cold symptoms, mainly in children. Moreover, Mainous & Hueston (1998) examined the use of antibiotics to treat URTIs in outpatient setups in USA, and found that 23% of the total cost was for the unnecessary use of antibiotics. Pestotnik, Classen, Evans, & Burke(1996) assert that antimicrobial agents are one of the costliest drug categories in hospital expenditures, accounting for approximately 20% to 50% of the total spending on drugs in USA.These studies are supportive of Main-

ous & Hueston(1998), who believed that it is important to reduce the use of inappropriate treatments for low-cost, high-volume conditions, such as antibiotics for URTIs, since it has significant implications for the cost of health care.

The financial burden of the emergence of bacterial resistant strains is significant. Studies have confirmed that the emergence of bacterial resistance strains leads to significant economic loss, since the cost of length-of-stay and treatment of patients with bacterial resistance infections are significantly increasing(Emanuele, 2010; Mora, et al., 2002). According to Mora, et al. (2002), Almost 100 million dollars are estimated to be spent annually in USA to treat patients with resistant bacterial infections. Minimizing the overuse of antibiotics will lead to reduction in bacterial resistance pattern; which will consequently deflate the excessive cost spent for treatment.

Table 2. Factors influencing antibiotics misuse/overuse.

Factors	Country
Parents' pressure	USA (Barden, et al., 1998)
	Canada (Butler, et al., 2001)
	UK (Britten & Ukoumunne, 1997)
	China (Chan, 1996)
	USA (Huang, et al., 2007)
	UK(Macfarlane, et al., 1997)
	USA(Mangione-Smith, et al., 1999)
	Canada (Paluck, et al., 2001)
	Kuwait(Sorkhou, et al., 2002)
Scio-economic status:	KSA (Al-Faris & Al-Taweel, 1999)
	USA (Barden, et al., 1998)
	USA (Braun & Fowles, 2000)
	Canada(Butler, et al., 2001)
	Moldova (Cebotarenco & Bush, 2007)
	China (Chan, 1996)
	UK (Davey, et al., 2002).
	USA(Huang, et al., 2007)
	Canada (Kozyrskyj, et al., 2004)
	Hungary(Maria; Matuz, et al., 2005)
	Canada (Paluck, et al., 2001)
	USA (Vanden Eng, et al., 2003)
Self-medication	Turkey(Akici, Kalaca, Ugurlu, & Oktay, 2004)
	Jordan (Al-Azzam, Al-Husein, Alzoubi, Masadeh, & Al-Horani, 2007)
	Jordan (Al-Bakri, Bustanji, & Al-Motassem, 2005)
	Sudan(Awad, Eltayeb, Matowe, & Thalib, 2005)
	KSA(Bawazir, 1992)
	China(Bi, Tong, et al., 2000)
	Moldova(Cebotarenco & Bush, 2007)
	Europe(Grigoryan, et al., 2007)
	USA(Kogan, Pappas, Yu, &Kotelchuck, 1994)
	Developing countries (Kunin, et al., 1987)
	Iran(Sarahroodi, et al., 2010)

USA United Sates of America
UK United Kingdom
KSA Kingdom of Saudi Arabia

3.2.3. Side effects

Several side effects may occur from over consumption or inappropriate consumption of antibiotics. A risk of adverse gastrointestinal effects may be caused by antibiotics over use (Irshaid, et al., 2004; Simasek & Blandino, 2007). According to Schroeder & Fahey (2002), drowsiness, diarrhea and hyperactivity are also significant side effects related to antibiotic use in children. These adverse effects are more significant in children (Simasek & Blandino, 2007). Moreover, Mora et al. (2002) suggest that adverse events may occur when people use multiple drugs, which may be associated with the increase in resistant bacterial infections. Goolsby(2001) believes that it is important to increase patients'/parents' awareness regarding antibiotics potential to inflict unnecessary side effects, such as, gastrointestinal effects, allergies, the development of antibiotic-resistant strains, and other infections. Al-Faris & Al Taweel(1999) suggest that doctors also need to be aware of the lack of evidence of effectiveness of antibiotics in the treatment of URTIs, as well as the obvious cost and side effects of many prescriptions for self-limiting conditions. Problems associated with the unjustified use of antibiotics, emphasize the need to educate the community (doctors and parents) about the consequences of the overuse of antibiotics, especially for the treatment of URTIs in children. Therefore, information about patterns of antibiotics utilization and factors influencing this pattern are necessary to be collected in order to develop a constructive approach to minimize this important public health issue.

3.3 Factors Influencing the Overuse of Antibiotics

The problem of antibiotic misuse may be influenced by several contributing factors, such as cultural, cognitive (e.g. parents pressure), educational, and socio-economic factors integrated at the level of patients or parents, physicians and pharmaceutical industries (Table.2).

3.3.1. Parents' Pressure

Parental expectation (Real or perceived) is a major factor that influences physicians' prescribing behavior. Studies have revealed that most parents expect physicians to prescribe antibiotics for their children even when presenting with viral infections such as most URTIs (Huang, et al., 2007). A survey conducted in Hong Kong showed that almost one third of the respondents (adult patients and guardians) presented at the family practice center particularly to obtain antibiotics (Chan, 1996). In addition, about half of pediatricians in USA report frequent parental pressure to prescribe non-indicated antibiotics (Huang, et al., 2007). In Canada nearly half of the physicians believe that they would reduce their antibiotic prescribing if parents pressure for prescriptions was reduced (Paluck, et al., 2001). Parental perceptions regarding antibiotics prescription have a huge impact on physicians' decision-making.Several researchers believe that although physicians might feel uncomfortable in prescribing antimicrobial to children with URTIs, they may resort to irrational prescription in order to foster good relationship with patients' guardians (Barden, Dowell, Schwartz, & Lackey, 1998; Butler, et al., 2001; Mangione-Smith, McGlynn, Elliott, Krogstad, & Brook, 1999).Sorkhou et al.(2002) conducted a study in Kuwait (a country similar to

Saudi Arabia geographically and culturally) to evaluate the factors influencing the antibiotic misuse, and found that many physicians feel obliged to prescribe antibiotics to their patients assuming the patients' or guardians' desire for such medication. However, this irrational prescribing behavior may encourage parents' false idea of antibiotics to treat URTIs and its side effects.

The problem of antibiotic over prescribing may also be associated with parents' expectations regarding antibiotics or physicians' perception about parents' expectation. Britten & Ukoumunne(1997) concluded from their study in London, UK that patients' expectations for prescriptions exceeded doctors' perceptions of these expectations. On the other hand, Macfarlane, Holmes, & Britten (1997) believed that physicians' generally overestimate patients' expectations. Therefore, it is important to identify the source of the overuse of antibiotics to treat URTIs, whether it is physicians' prescribing behavior, parents' expectations, or an interaction between parents' expectations and physicians prescribing behavior. Thus, suggesting an intervention strategy that would be beneficial in reducing this inappropriate use of antibiotics.

3.3.2. Lack of Health Education

Health education is an important factor contributing to the escalating problem of antibiotic over prescription. Cebotarenco & Bush(2007) revealed that patients' or parents' lack of knowledge in antibiotics therapy (i.e. to treat bacterial infections) and the harmful effect caused by inappropriate use (i.e. to treat viral infections) is a contributing factor to the trend of antibiotic misuse. For example, the majority of the parents of patients attending family practice centers in Hong Kong had a false notion that URTIs affecting their children would not resolve on its own and antibiotics are necessary to treat the symptoms (Chan, 1996). Cebotarenco & Bush(2007) believed that parents' misconceptions about appropriate indication for antibiotics use leads to an increase in their children's consumption of antibiotics often without physicians' knowledge. Moreover, almost all physicians (93.5%) in a study conducted in Canada believed that educating parents about antibiotics and their implications would reduce expectations for antibiotics (Paluck, et al., 2001). Patients' lack of health education needs to be emphasized in order to minimize the irrational use of antibiotics.

Health education could take place in physician's offices, schools, and universities. However, evidence shows that health education is minimal in many pediatric clinics, which may be due to the lack of time. Several researchers considered the lack of time to negotiate a different management plan as an important issue that needs to be addressed in order to improve antibiotics prescription practices (Davey, Pagliari, & Hayes, 2002). Huang et al.(2007) revealed that mothers often felt that physicians do not clarify why an antibiotic is not needed. Evidence shows that in a Saudi health care centre, 75% of consultations ended with a prescription, while health education took place in only 7.6% of the consultations (Al-Faris & Al-Taweel, 1999). These international figures emphasize the importance of health education programs at the community level in order to have a healthier population.

The physician-patient relationship needs to be investigated in the population in order to improve the practice. Several physician–patient interaction models have been suggested to improve proper antibiotic prescribing decisions (Butler, et al., 2001). Barden et al. (1998) reported that parents believed that physicians' cooperation in regards to listening to the patients concern, answering their questions, and explaining the reasons for treatment, will lead to their satisfaction even where antibiotics are not prescribed. Development of educational programs for physicians combined with community education is necessary to minimize the antibiotic misuse and the burden of bacterial resistance.

3.3.3. Socio-economic Status

Socio-economic status needs to be considered as an important factor contributing to the rising issue of antibiotic misuse. Kozyrskyj et al. (2004) believed that inappropriate consumption of antibiotics is related to low socio-economic status, which might be associated to low education levels. Similarly, Matuz et al. (2005) suggest that poor socio-economic status is associated with antibiotic consumption in Hungary.On the other hand, it was argued that parents with high socio-economic status are more likely to request antibiotics, because of the parents believe that antibiotics treat URTIs faster, thus reducing the time taken off work (Braun & Fowles, 2000; Vanden Eng, et al., 2003). Braun & Fowles(2000) argued that full-time employed parents are more likely to request antibiotics. Results from the Vanden Eng et al. (2003) study shows that patients with higher socioeconomic status are more likely to consume antibiotics, which may be due to their better access to health care services. Although many researchers considered patients' socioeconomic status as an important factor in the use of antibiotics (Braun & Fowles, 2000; Kozyrskyj, et al., 2004; Maria Matuz, et al., 2005; Vanden Eng, et al., 2003), there is a lack of worldwide information regarding the association between socioeconomic status and antibiotic use, therefore, it is important to study this association, as a contribution to the knowledge gaps.

3.3.4. Self-medication

Self-medication was identified by Kunin et al.(1987) as self-administering inadequate doses of non-prescription medicines prior to doctors' diagnosis. High rate of self-medication, especially antibiotic self-medication, may cause several problems to the child: it slows down children development, increases drug resistance, creates an unbalanced bacteria distribution, and leads to other side effects (Bi, Tongb, & Partonc, 2000). Moreover, studies have been conducted to measure the extent of parental self-medication to their children. In Turkey, Akici, Kalaca, Ugurlu, & Oktay(2004), found that almost 60% of parents had

self-medicated their children before visiting the doctor. Likewise, Bi et al. (2000) found that almost 59% of children in China had parental self-medication. Furthermore, URTIs were the most common reasons for self-medication in Europe (Grigoryan, et al., 2007). It is necessary to consider the problem of self-medication when exploring factors influencing antibiotics misuse.

Self-medication is more common in developing countries due to factors such as ready availability of antibiotics without prescription, the unrestricted access to antibiotics,lack of regulation over drugs, and physicians and pharmacists prescribing and dispensing antibiotics without regard to the cause of infection(Bawazir, 1992 ; Bi, Tong, et al., 2000; Cebotarenco & Bush, 2007; Grigoryan, et al., 2007; Le, et al., 2011). Bi et al. (2000) also studied factors associated with parental self-medication in China and found that well-educated mothers are more likely to self-medicate their child, parental self-medication usually increases with the age of the child, and severity of disease was related to parental self-medication (i.e. when the diseases were not serious self-medication and antibiotics misuse are more likely to occur). Grigoryan et al.(2007) reported that past experience with prescribed use of antibiotics triggers people to use self-medication. These factors may vary according to geographical locations, social behaviors, patients' educational status, and cultural factors. Self-medication is an important issue in Saudi Arabia (Bawazir, 1992) and several adjacent countries such as Iran (Sarahroodi, et al., 2010), Jordan (Al-Azzam, et al., 2007; Al-Bakri, et al., 2005) and Sudan (Awad, et al., 2005). However, self-medication is a significantly growing public health issue in developed countries as well as developing countries (Bi, Tongb, et al., 2000). For example, a survey in USA showed that 54% of children had parental self-medication (Kogan, et al., 1994). Factors influencing this behavior (self-medication) in Saudi Arabia need to be measured in order to minimize to the overuse of antibiotics in children with URTIs and therefore reducing antibacterial resistance in the community.

3.4. Interventions to Prevent Overuse of Antibiotics

Carefully planned and well-designed methodological intervention can result in behavior change for achieving the expected outcome. Several intervention protocols have been implemented around the world to reduce the overuse of antibiotics. It is important to investigate these worldwide intervention strategies and find the best protocol to be used in countries like Saudi Arabia according to the contributing factors to this overuse of antibiotics.

3.4.1 Health Education

Evidence shows that careful health professional education in addition to patient awareness would be effective in reducing excessive use of antibiotics (Green, 2006; Panagakou, et al., 2011; Teng, et al., 2004). Public educational interventions may include: simple messages delivered by public relation campaigns, clinic-based education and community-wide educational materials (e.g. printed leaflets)(Belongia & Schwartz, 1998). All of these methods could be effective in delivering information about the use of antibiotics to the general population. There is a need for educational programs for physicians; Croft et al. (2007) suggested that physicians should receive evidence-based recommendations for diagnosis and treatment from professional societies, as well as feedback about their antibiotic use to facilitate behavior change. Although some methods were proven to be effective, some of the interventions targeting physicians were evidently ineffective. Arnold & Straus(2005) compared different intervention strategies around the world to find the most effective interventions in reducing the overuse of antibiotics: physicians' printed educational materials, audits, and feedback were found to be ineffective, but educational meetings appeared to be more effective.

Several studies have also found that multi-faceted interventions, directed at both patients'/guardians' level and doctors' level, are more successful in reducing the inappropriate use of antibiotics than a single intervention (Belongia, et al., 2002); Combining health care provider, patient, and public education after addressing local barriers to change(Arnold & Straus, 2005; Belongia & Schwartz, 1998; Gonzales, Barrett, Crane, & Steiner, 1998). Rising public and health care providers' awareness regarding antibiotics is evidently effective in reducing antibiotic misuse. However, delivering such education may differ according to the setting where the intervention strategy is targeted.

3.4.2. Doctor-patient Communication

Shared decision making has been shown to be an effective tool that can help in reducing overuse of antibiotics, where the physician provides clear information about the disease and treatment, and the patients provide their experience of the symptom and their beliefs, and knowledge about the treatment (Akici, et al., 2004; Butler, et al., 2001). This way both the patients' guardians and the physician facilitate the decision-making process. Furthermore,Britten & Ukoumunne(1997) suggest that physicians may ask the patients or their guardians directly if they were hoping for an antibiotic, leading to the discussion of the reasons for such expectations. Moreover, Belongia & Schwartz(1998) believe that physicians should be convinced that patients' satisfaction is based on communication more than prescription. Patient-physician communication is clearly important. Thus, interventions targeted at improving this communication may lead to a decrease in antibiotics overuse.

3.4.3. Changing Policies

Some studies advocate developing organizational policies or review of existing ones, to support judicious use of antibiotics (Belongia & Schwartz, 1998; Radyowijati & Haak, 2003). While others, believe that a computerized antibiotic-management program can improve the overall quality of patient care(Evans, et al., 1998). The latter was confirmed

by a seven year intervention study by Pestotnik et al. (1996), which found that using computer-based decision-making programs with specific guidelines brought about a remarkable reduction in antibiotic misuse and its associated cost. Furthermore, implementing a policy for delaying antibiotic prescription for 48 hours is another method that was suggested by Spurling, Del Mar, Dooley, & Foxlee(2006), this may give self-limiting conditions time to heal without using medications. Evidently this method is likely to be effective in reducing antibiotic use, however, it may as well reduce patient satisfaction. Although policy change is an effective method in reducing antibiotic overuse, targeted policies need to be reviewed before suggesting the intervention strategy in order to ascertain the aspects that need to be improved.

4. Conclusions

Antibiotics misuse/overuse is an important public health issue that affects the community and the individual. Using antibiotics to treat children from upper respiratory tract infections is evidently inappropriate unless the infection was proven to be bacterial. This misuse of antibiotics, especially in children, will increase the risk of developing bacterial resistance which emphasis on the need to discover the contributing factors to this overuse of antibiotics. Factors influencing the misuse/overuse of antibiotics in the literature include (1) psychosocial factors, such as: behaviors, beliefs, and attitudes (e.g., self-medication & over-the-counter medication), (2) parents pressure, often documented by doctors, (3) demographic characteristics (e.g., socio-economic status, education levels) and (4) and lack of health education. Discovering the factors affecting the misuse/overuse of antibiotics in Saudi Arabia, whether they are patients'/ parents'-related or doctors'-related could assist in the development and implementation of a well-designed methodological intervention protocol that can lead to a decrease in antibiotics use.

Interventions that could lead to the reduction in antibiotics overuse may include: (1) health education campaigns, professional education as well as public awareness campaigns are evidently effective in the reduction of the unnecessary use of antibiotics in children with upper respiratory tract infections. (2) Doctor-patients interactions, where the patient/parent gets involved in the decision making process with the doctor. And/or (3) policy change, such as: implementing a new policy for delaying antibiotics prescription for 48 hours which will give the self-limiting conditions to time to heal without the use of medications. Choosing the best intervention protocol relays on discovering the most influencing factor(s) associated with this overuse.

REFERENCES

[1] Ahmed, K., & Al-Saadi, A. (2005). A survey of multiple prescriptions dispensed in Saudi Arabia. Pakistan Journal of Pharmaceutical Sciences, 18(2), 1-2

[2] Akici, A., Kalaca, S., Ugurlu, U., & Oktay, S. (2004). Prescribing habits of general practitioners in the treatment of childhood respiratory-tract infections. Eur J Clin Pharmacol, 60, 211-216

[3] Al-Azzam, S., Al-Husein, B., Alzoubi, F., Masadeh, M., & Al-Horani, M. (2007). Self-Medication with Antibiotics in Jordanian Population. IJOMEH, 20(4), 373-380

[4] Al-Bakri, A., Bustanji, Y., & Al-Motassem, Y. (2005). Community consumption of antibacterial drugs within the Jordanian population: sources, patterns and appropriateness. International Journal of Antimicrobial Agents, 26(5), 389 - 395

[5] Al-Faris, E., & Al-Taweel, A. (1999). Audit of prescribing patterns in Saudi primary health care: What lessons can be learned? Ann Saudi Med, 19(4), 317-321

[6] Ali, M., & Ahmed, M. (1995). Problems of drug prescription at primary health care centres in Southern Saudi Arabia. Saudi Medical Journal, 16(3), 213-216

[7] Arnold, S., & Straus, S. (2005). Interventions to improve antibiotic prescribing practices in ambulatory care (Review) Cochrane Database of Systematic Reviews(4)

[8] Arroll, B., & Kenealy, T. (2005). Antibiotics for the common cold and acute purulent rhinitis (Review). Cochrane Database of Systematic Reviews(3)

[9] Awad, A., Eltayeb, I., Matowe, L., & Thalib, L. (2005). Self-medication with Antibiotics and Antimalarials in the community of Khartoum State, Sudan J Pharm Pharmaceut Sci 8(2), 326-331

[10] Barden, L., Dowell, S., Schwartz, B., & Lackey, C. (1998). Current Attitudes Regarding Use of Antimicrobial Agents: Results from Physicians' and Parents' Focus Group Discussions. Clinical Pediatrics, 37(11), 665-671

[11] Bawazir, S. (1992). Prescribing pattern at Community Pharmacies in Saudi Arabia. International Pharmacy Journal, 6(5)

[12] Belongia, E., Naimi, T., Gale, C., & Besser, R. (2002). Antibiotic Use and Upper Respiratory Infections: A Survey of Knowledge, Attitudes, and Experience in Wisconsin and Minnesota. Preventive Medicine, 34(3), 346-352

[13] Belongia, E., & Schwartz, B. (1998). Strategies for promoting judicious use of antibiotics by doctors and patients. BMJ, 317(7159), 668-671

[14] Bennet, J., & Geme, J. (1999). Bacterial Resistance and Antibiotic Use in The Emergency Department. Pediatric Clinics of North America, 46(6), 1125-1143

[15] Bhasin, S., Budden, E., Ketkar, A., & Pawar, A. (2002). Current trends in the treatment of upper respiratory tract infections in neonates, infants and children: A survey. Indian Journal of Pharmacology, 34, 62-63

[16] Bi, P., Tong, S., & Partonc, K. (2000). Family self-medication and antibiotics abuse for children and juveniles in a Chinese city. Social Science & Medicine, 50(10), 1445-1450

[17] Bi, P., Tongb, S., & Partonc, K. (2000). Family self-medication and antibiotics abuse for children and juveniles in a Chinese city. Social Science & Medicine, 50(10), 1445-1450.

[18] Braun, B., & Fowles, J. (2000). Characteristics and Experiences of Parents and Adults Who Want Antibiotics for Cold Symptoms. Arch Fam Med, 9(7), 589-595

[19] Britten, N., & Ukoumunne, O. (1997). The influence of patients' hopes of receiving a prescription on doctors' perceptions and the decision to prescribe: a questionnaire survey. BMJ, 315(7121), 1506-1510

[20] Butler, C., Kinnersley, P., Prout, H., Rollnick, S., Edwards, A., & Elwyn, G. (2001). Antibiotics and shared decision-making in primary care. Journal of Antimicrobial Chemotherapy, 48(3), 435-440

[21] Cebotarenco, N., & Bush, P. (2007). Reducing antibiotics for colds and flu: a student-taught program. Health Education Research, cym008

[22] Chan, C. (1996). What do patients expect from consultations for upper respiratory tract infections? Family Practice, 13(3), 229-235

[23] Chang, S., Shiu, M., & Chen, T. (2001). Antibiotic usage in primary care units in Taiwan after the institution of national health insurance. Diagnostic microbiology and infectious disease, 40(3), 137-143

[24] Croft, D., Knobloch, M., Chyou, P., Ellen, D., Janette, C., Davis, J., et al. (2007). Impact of a child care educational intervention on parent knowledge about appropriate antibiotic use. Wisconsin Medical Journal, 106(2), 78-84

[25] Davey, P., Pagliari, C., & Hayes, A. (2002). The patient's role in the spread and control of bacterial resistance to antibiotics. Clinical Microbiology and Infection, 8(2), 43-68

[26] El-Gilany, A. (2000). Acute respiratory infections in primary health care centres in northern Saudi Arabia. Eastern Mediterranean Health Journal, 6(5), 955-960

[27] Emanuele, P. (2010). Antibiotic Resistance. AAOHN Journal, 58(9), 363-363-365

[28] Evans, R., Pestotnik, S., Classen, D., Clemmer, T., Weaver, L., Orme, J., et al. (1998). A Computer-Assisted Management Program for Antibiotics and Other Antiinfective Agents. New England Journal of Medicine, 338(4), 232-238

[29] Fahey, T., Stocks, N., & Thomas, T. (1998). Systematic review of the treatment of upper respiratory tract infection Arch Dis Child, 79, 225-230

[30] Flora, K., Scott, W., Jason, B., & Jonathan, Z. (2008). Improving antibiotic utilization among hospitalists: A pilot academic detailing project with a public health approach. Journal of Hospital Medicine, 3(1), 64-70

[31] Foster, C., & Sabella, C. (2011). Health Care-Associated Infections in Children. JAMA, 305(14), 1480-1481

[32] Gonzales, R., Barrett, P., Crane, L., & Steiner, J. (1998). Factors associated with antibiotic use for acute bronchitis. JGIM, 13(8), 541-548

[33] Goolsby, M. (2001). Viral Upper Respiratory Infections. Journal of the American Academy of Nurse Practitioners, 13(2), 50-54

[34] Green, R. (2006). Symptomatic treatment of upper respiratory tract symptoms in children South African Family Practice, 48(4), 14-19

[35] Grigoryan, L., Burgerhof, J., Haaijer-Ruskamp, F., Degener, J., Deschepper, R., Monnet, D., et al. (2007). Is self-medication with antibiotics in Europe driven by prescribed use? Journal of Antimicrobial Chemotherapy, 59(1), 152-156

[36] Hoa, N. Q., Chuc, N. T. K., Phuc, H. D., Larsson, M., Eriksson, B., & Lundborg, C. S. (2011). Unnecessary antibiotic use for mild acute respiratory infections during 28-day follow-up of 823 children under five in rural Vietnam. Transactions of the Royal Society of Tropical Medicine and Hygiene

[37] Hoa, N. Q., Larson, M., Chuc, N. T. K., Eriksson, B., Trung, N. V., & Stalsby, C. L. (2009). Antibiotics and paediatric acute respiratory infections in rural Vietnam: health-care providers‚Äô knowledge, practical competence and reported practice. Tropical Medicine & International Health, 14(5), 546-555

[38] Huang, S., Rifas-Shiman, S., Kleinman, K., Kotch, J., Schiff, N., Stille, C., et al. (2007). Parental Knowledge About Antibiotic Use: Results of a Cluster-Randomized, Multicommunity Intervention. Pediatrics, 119(4), 698-706

[39] Irshaid, Y., Al-Homrany, M., Hamdi, A., Adjepon-Yamoah, K., & Mahfouz, A. (2004). A pharmacoepidemiological study of prescription pattern in outpatient clinics in Southwestern Saudi Arabia. Saudi Medical Journal, 25(12), 1864-1870

[40] JETACAR. (1999). The use of Antibiotics in Food-producing animals. Commonwealth of Australia

[41] Kogan, M., Pappas, G., Yu, S., & Kotelchuck, M. (1994). Over-the-counter Medication Use Among US Preschool-age Children. JAMA, 272(13), 1025-1030

[42] Kozyrskyj, A., Dahl, M., Chateau, D., Mazowita, G., Klassen, T., & Law, B. (2004). Evidence-based prescribing of antibiotics for children: role of socioeconomic status and physician characteristics. Canadian Medical Association Journal 171(2), 139-145

[43] Kunin, C., Lipton, H., Tupasi, T., Sacks, T., Scheckler, W., Jivani, A., et al. (1987). Social, Behavioral, and Practical Factors Affecting Antibiotic Use Worldwide: Report of Task Force 4. Reviews of Infectious Diseases, 9(3), 270-285

[44] Le, T. H., Ottosson, E., Nguyen, T. K. c., Kim, B. g., & Allebeck, P. (2011). Drug use and self-medication among children with respiratory illness or diarrhea in a rural district in Vietnam: a qualitative study Journal: Journal of Multidisciplinary Healthcare 4(1), 329-336

[45] Macfarlane, J., Holmes, W., Macfarlane, R., & Britten, N. (1997). Influence of patients' expectations on antibiotic management of acute lower respiratory tract illness in general practice: questionnaire study. BMJ, 315(7117), 1211-1214

[46] Mainous, A., & Hueston, W. (1998). The Cost of Antibiotics in Treating Upper Respiratory Tract Infections in a Medicaid Population. Arch Fam Med, 7(1), 45-49

[47] Mainous, A., Hueston, W., Davis, M., & Pearson, W. (2003). Trends in Antimicrobial Prescribing for Bronchitis and Upper Respiratory Infections Among Adults and Children.

American Journal of Public Health, 93(11), 1910-1914

[48] Mangione-Smith, R., McGlynn, E., Elliott, M., Krogstad, P., & Brook, R. (1999). The Relationship Between Perceived Parental Expectations and Pediatrician Antimicrobial Prescribing Behavior. Pediatrics, 103(4), 711-718

[49] Matuz, M., Benko, R., Doro, P., Hajdu, E., Nagy, G., Nagy, E., et al. (2005). Regional variations in community consumption of antibiotics in Hungary, 1996–2003. Br J clin Pharmac, 61(1), 96–100

[50] Matuz, M., Benko, R., Doro, P., Hajdu, E., Nagy, G., Nagy, E., et al. (2005). Regional variations in community consumption of antibiotics in Hungary, 1996–2003. British Journal of Clinical Pharmacology, 61(1), 96–100

[51] McCutcheon, H., & Fitzgerald, M. (2001). The public health problem of acute respiratory illness in childcare. Journal of Clinical Nursing, 10(3), 305-310

[52] Mora, Y., Avila-Agtiero, M., Umafia, M., Jimenez, A., Paris, M., & Faingezicht, I. (2002). Epidemiologic observations of the judicious use of antibiotics in a pediatric teaching hospital. International Journal of Infectious Diseases, 6(1), 74-77

[53] Nyquist, A.-C., Gonzales, R., Steiner, J., & Sande, M. (1998). Antibiotic Prescribing for Children With Colds, Upper Respiratory Tract Infections, and Bronchitis. JAMA, 279(11), 875-877

[54] Palmer, D., & Bauchner, H. (1997). Parents' and Physicians' Views on Antibiotics. Pediatrics, 99(6)

[55] Paluck, E., Katzenstein, D., Frankish, J., Herbert, C., Milner, R., Speert, D., et al. (2001). Prescribing practices and attitudes toward giving children antibiotics. Canadian Family Physician, 47, 521–527

[56] Panagakou, S. G., Spyridis, N., Papaevangelou, V., Theodoridou, K. M., Goutziana1, G. P., Theodoridou, M. N., et al. (2011). Antibiotic use for upper respiratory tract infections in children: A cross-sectional survey of knowledge, attitudes, and practices of parents in Greece. BMC Pediatrics, 11(60)

[57] Peche're, J. (2001). Patients' Interviews and Misuse of Antibiotics. Clinical Infectious Diseases, 33(S3), S170-S173

[58] Pestotnik, S., Classen, D., Evans, S., & Burke, J. (1996). Implementing Antibiotic Practice Guidelines through Computer-Assisted Decision Support: Clinical and Financial Outcomes American College of Physicians 124, 884-890

[59] Radyowijati, A., & Haak, H. (2003). Improving antibiotic use in low-income countries: An overview of evidence on determinants. Social Science & Medicine, 57, 733-744

[60] Sarahroodi, S., Arzi, A., Sawalha, A., & Ashtarinezhad, A. (2010). Antibiotics self-medication among southern iranian university students. International Journal of Pharmacology, 6, 48-52

[61] Schroeder, K., & Fahey, T. (2002). Should we advise parents to administer over the counter cough medicines for acute cough? Systematic review of randomised controlled trials. Arch Dis Child, 86, 170–175

[62] Simasek, M., & Blandino, D. (2007). Treatment of the common cold. American Family Physician, 75(4), 515-520

[63] Simoes, E., Cherian, T., Chow, J., Shahid-Salles, S., Laxminarayan, R., & John, T. (2006). Disease Control Priorities in Developing Countries (2nd edition ed.)

[64] Skull, S., Ford-Jones, E., Kulin, N., Einarson, T., & Wang, E. (2000). Child Care Center Staff Contribute to Physician Visits and Pressure for Antibiotic Prescription. Arch Pediatr Adolesc Med, 154(2), 180-183

[65] Sorkhou, I., Al-Qallaf, B., Hajiah, A., Al-Sheibani, H., Bayoomi, A., & Mustafa, A. (2002). Perceptions of Patients Attending Primary Care in Kuwait Regarding Upper Respiratory Tract Infections. Kuwait medical Journal, 34(4), 272-275

[66] Spurling, G., Del Mar, C., Dooley, L., & Foxlee, R. (2006). Delayed antibiotics for respiratory infections. Cochrane Database of Systematic Reviews(2)

[67] Teng, C., Leong, K., Aljunid, S., & Cheah, M. (2004). Antibiotic Prescription In Upper Respiratory Tract Infections. Asia Pacific Family Medicine, 3(1-2), 38-45

[68] Tenover, F. (2006). Mechanisms of Antimicrobial Resistance in Bacteria. The American Journal of Medicine, 119(6), 3–10

[69] Vanden Eng, J., Marcus, R., Hadler, J., Imhoff, B., Vugia, D., Cieslak, P., et al. (2003). Consumer attitudes and use of antibiotics. Emerging Infectious Diseases Journal, 9(9), 1128-1135

[70] Waksman, S. (1947). What Is an Antibiotic or an Antibiotic Substance? Mycologia 39(5), 565–569

[71] West, J. (2002). Acute upper airway infections: Childhood respiratory infections. British Medical Bulletin, 61(1), 215-230

[72] Wutzke, S., Artist, M., Kehoe, L., Fletcher, M., Mackson, J., & Weekes, L. (2007). Evaluation of a national programme to reduce inappropriate use of antibiotics for upper respiratory tract infections: effects on consumer awareness, beliefs, attitudes and behaviour in Australia. Health Promotion International, 22(1), 53-64

Chapter 3: Literature Review (Part 2)

Title: Validity and reliability of instruments designed to measure factors influencing the overuse of antibiotics

Citation: Alumran A, Hou X-Y, Hurst C: Validity and reliability of instruments designed to measure factors influencing the overuse of antibiotics. *Journal of Infection and Public Health* 2012, 5:221-232.

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Contribution of authors:

The candidate reviewed the literature and wrote the manuscript. All authors provided feedback and valuable input on the initial draft of the manuscript.

Summary of results:

This literature review assessed available measurement instruments in the literature directed to measure the factors influencing the overuse of antibiotics. The article included background discussion about the full workup of a measurement instrument, early stage validation (content and face validation), middle stage validation (construct validation), and final stage validation (criterion-related validity, and convergent and discriminant validity). Further, existing scales were reviewed thoroughly in this article to assess the validity and reliability of these existing scales. The existing scales were categorized into three different groups, including: (1) scales

directed at patients/parents, (2) scales directed at doctors, and (3) scales directed at both patients and doctors.

This study examines the development and implementation of the existing scales independently. The study revealed that of the published scales that were designed to measure the factors influencing the overuse of antibiotics, none of which was fully validated. Some studies attempted to achieve content or face validation of their scales, but none of which mentioned full validation process of their instruments. Therefore, it is important to develop an instrument that measures the factors influencing the use of antibiotics in children, and fully validate the instrument. A valid and reliable instrument is going to enable us to discover the underlying factors leading to antibiotic use in Saudi Arabia, which in turn will facilitate the decision-making and generation of effective intervention strategies that are targeted to reduce the use of antibiotics.

Inclusion Criteria:

The inclusion criteria required that only articles that measured patterns of antibiotic use were included in this study.

Key words:

Validity, Reliability, Measurement, Instrument, Antibiotics, Psychosocial factors.

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Statement of Contribution of Co-Authors for Thesis by Published Paper

The following is the format for the required declaration provided at the start of any thesis chapter which includes a co-authored publication.

The authors listed below have certified* that:

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2. they take public responsibility for their part of the publication, except for the responsible author who accepts overall responsibility for the publication;
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Publication title and date of publication or status: Validity and reliability of instruments designed to measure factors influencing the overuse of antibiotics

Contributor	Statement of contribution*
Arwa Alumran  30/10/2013	The candidate reviewed the literature and wrote the manuscript. All authors provided feedback and valuable input on the initial draft of the manuscript.
Xiang-Yu Hou	Provided feedback and valuable input on the initial draft of the manuscript.
Cameron Hurst	Provided feedback and valuable input on the initial draft of the manuscript.

Principal Supervisor Confirmation

I have sighted email or other correspondence from all Co-authors confirming their certifying authorship.

Xiang-Yu Hou		13/11/2013
Name	Signature	Date

Chapter 4: Research Design

This study assessed the parental use of antibiotics in children with URTIs. A psychosocial measurement instrument was developed for the purpose of this study and future studies with the same objectives. After the instrument's development, the instrument was fully validated and reliability of the instrument was tested. This chapter describes the design used in this study to achieve the aims and objectives stated in chapter 1. The chapter describes the methodology used, the stages where the methodology was implemented, and the design of the study. Also, a detailed description of the participants in the study is available in this chapter as well as the selection process of the participants. Data collection and analysis is described in this chapter. Finally, ethical considerations are mentioned in the final section in this chapter.

4.1. METHODOLOGY AND RESEARCH DESIGN

Methodology

The study was performed in three phases; Figure 4.1 shows the plan in details:

(1) First is the background data collection and information gathering. This include: a literature review and a systematic review to check if there are any fully validated scales that measure the psycho-social factors influencing parental use of antibiotics in children with URTIs. ***(Chapter 2 and Chapter 3)***.

(2) Instrument development and validation and data analysis:

   a. Data collection from a panel of experts using the Delphi Technique (qualitative component) that helped in the development of the instrument (the PAPA scale); which assessed in evaluating the

psychosocial factors influencing parental use of antibiotics in children with URTIs. **(Chapter 5).**

b. Preliminary validation of the developed instrument, this includes: translational, content validity, and face validity. **(Chapter 5).**

c. Data was collected from parents to perform exploratory factor analysis to assess the construct validity of the instrument. **(Chapter 6).**

d. Another data set was collected to perform construct and full validation of the PAPA instrument. **(Chapter 7)**

(3) Discovering the factors influencing the use of antibiotics in Saudi Arabia:

a. Modeling of the scales in the instruments by assessing each scale against a set of covariates from the questionnaire using general linear models. **(Chapter 8).**

b. Evaluating the parental use of antibiotics against a set of covariates, and against the scales in the instrument using ordinal logistic regression. **(Chapter 9).**

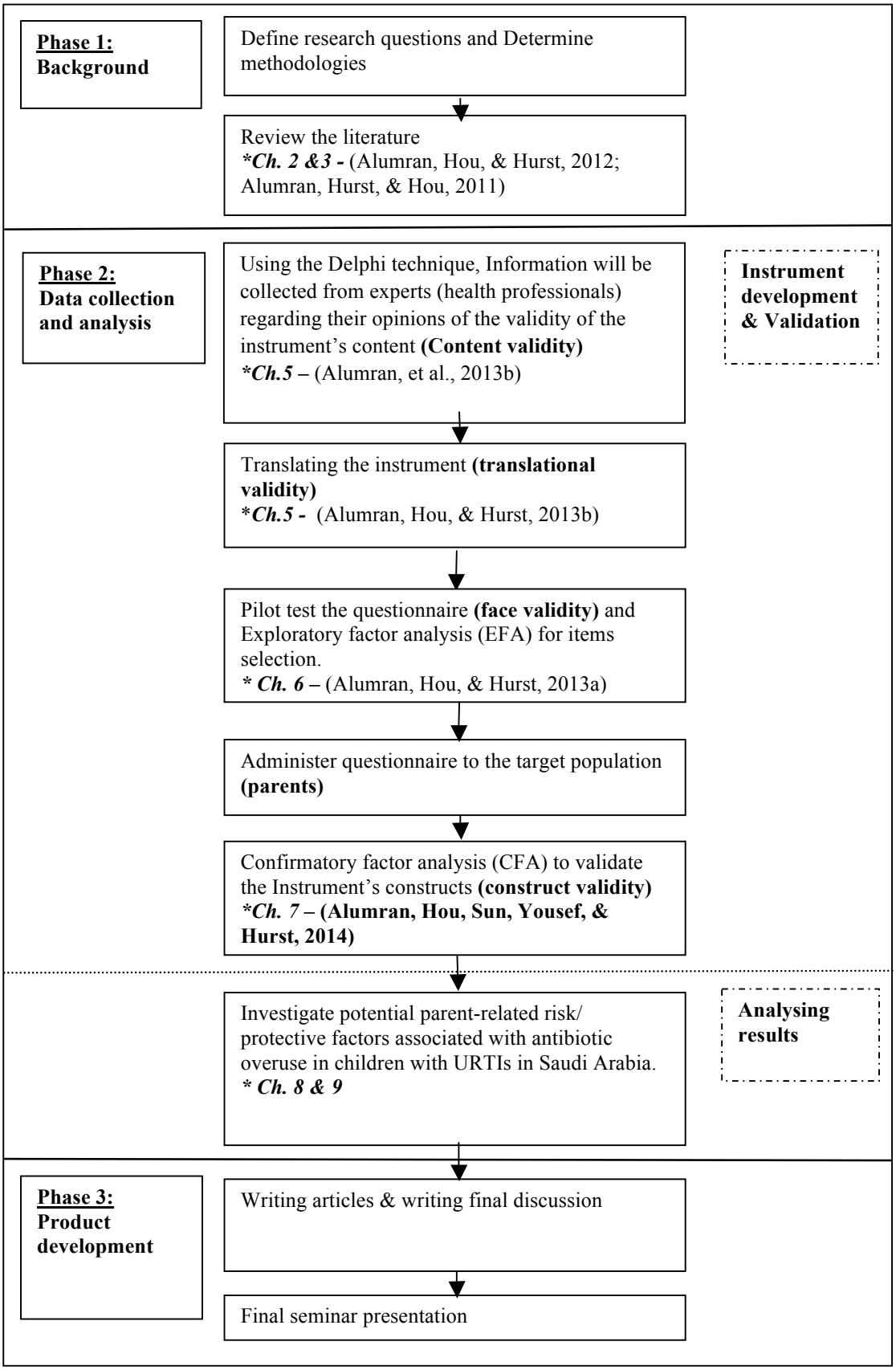

Figure 4.1 - The detailed study plan

Research Design

This research was conducted in several integrated stages:

1. Instrument Development:

Phase 1: Delphi Study (qualitative component):

The development of a measurement instrument aimed to measure parental psychosocial factors regarding the use of antibiotic in children with URTIs. Content validity and face validity were assessed in this early stage of the instrument's development. Content validity was assessed using the Delphi technique **(**Figure 4.2**)**, a pool of questions were created by the research team from the relevant literature (refer to ***Chapter 5*** for more details on the development of the PAPA instrument), ideas were then collected from experts regarding the relevance, clarity and un-ambiguity of the items included in the scale. Experts had the option to suggest new question, therefore, insuring the comprehensiveness of the instrument. The Delphi study was conducted in an iterative process on a 3 round basis until consensus was reached between the experts in regards to the instrument's content.

After the development of the instrument it was translated to Arabic by adapting Jones et al. (2001) method of translation, using the group approach when applying the back-translation method and the bilingual technique **(**Figure 4.3**)**. It is important to note that all of the translators used in the translation process are independent of each other.

** Please refer to **appendix A** for Arabic version of the PAPA instrument*

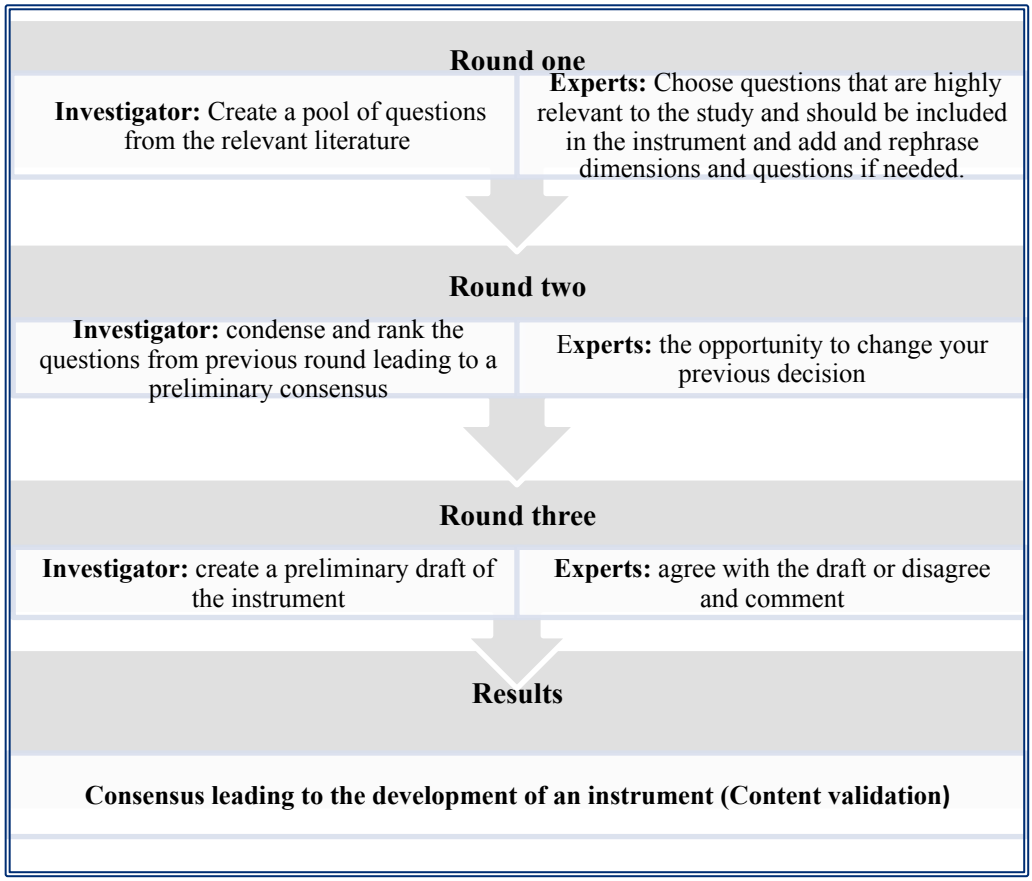

Figure 4.2 - The Delphi Technique Process

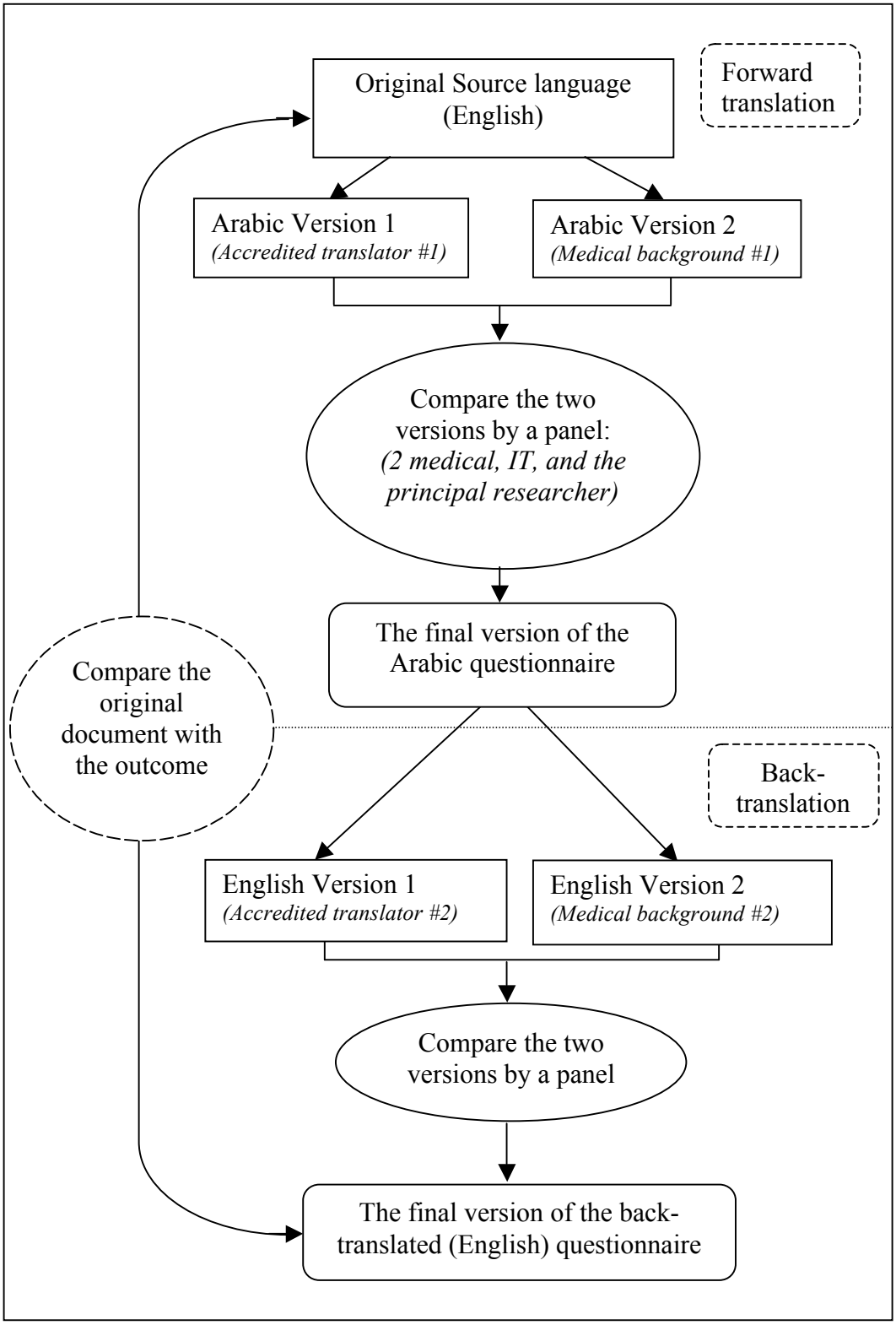

Figure 4.3 - Translation process

Phase 2 – Pilot study [EFA]:

A cross-sectional study was carried out to administer the newly developed, translated and content-validated questionnaire to the target population (parents). Participants completed the questionnaire that assessed in conducting Exploratory Factor Analysis (EFA) using principal axis factoring to determine the number and nature of the underlying constructs (Colton & Covert, 2007). Data collected from the sample was used to confirm face validity and the item selection process.

Phase 3 – full validation:

After applying the required modifications from the pilot study, a cross-sectional study was carried out to administer the questionnaire to the target population (parents). Data collected was used to fully validate the instrument using Confirmatory Factor Analysis (CFA) to assess the construct validity, convergent validity, and divergent validity of the instrument. Instrument reliability was assessed at this phase.

Further validation of the instrument such as criterion-related validity (predictive validity) is not achievable since it mostly relies on comparing the instrument with other validated instruments, and to our knowledge there was no validated instrument related to the area of antibiotics misuse (Alumran, et al., 2012). Therefore, such analysis is not going to be possible to achieve.

**Please refer to appendix B for the PAPA instrument*

2. Modelling the PAPA scales:

By using the same dataset collected for the full validation phase, the scales in the instrument were analysed against all of the variables in the instrument to develop the best regression model for each scale.

3. Discovering the factors influencing parental use of antibiotics in children in Saudi Arabia

The same dataset used in the full validation phase and modelling study was used to discover the contributing factors (including: psychosocial, demographic, or health-related factors) associated with the parental use of antibiotics in children in Saudi Arabia.

4.2. STUDY POPULATION AND PARTICIPANTS

Study population

The Kingdom of Saudi Arabia (KSA) is composed of 13 administrative region **(**Figure 4.4**),** covering an area of over 2 million square kilometres and a population of 27 million in 2008 (Central department of statistics and information, 2011). This study was conducted in the Eastern Province of Saudi Arabia, the largest geographical province (Mahrad, 2010). This province consists of a heterogeneous population representing a diversity of Saudi cultures and beliefs; thus providing generalizability to the study within the Saudi context.

Figure 4.4 - Districts of the Kingdom of Saudi Arabia

Source: (Saudia-online, 2013)

From the 27 million residents in Saudi Arabia, more than 9 million are children under 18 years old (Unicef, 2011). To the best of our knowledge, there is no study from the Kingdom of Saudi Arabia quantifying the burden of antibiotics use among children suffering from Upper Respiratory Tract Infections (URTIs). However, it was found that the worldwide average number of common cold episodes occurring in each child annually is 3-8 times (Duarte & Botelho, 2000; West, 2002).

In KSA, although the rules state that antibiotics need a doctor's prescription to be dispensed to patients (Bawazir, 1992). However, studies have revealed that pharmacies often do not follow these rules and a huge amount of antibiotics are dispensed without prescriptions (Al-Hassan, 2011; Bin Abdulhak, et al., 2011). Many of these distributed non-prescribed antibiotics are inappropriately dispensed by the pharmacists for viral infections, with and without the patient/parent request (Bin Abdulhak, et al., 2011). With the lack of strict regulations on over-the-counter

dispensing of antibiotics in Saudi Arabia, the choice of using an antibiotic relies entirely on the patient/parent.

Children's health-related decision-making is done by their parents; therefore our target population is all parents of children between the ages of 0 and 12 years old. We chose a cut-off of 12 years old to make sure we captured the population where parents are the main decision makers regarding the use of antibiotics, elder children are likely to make their own choices especially regarding adherence to the antibiotics regimen. Assessing the factors influencing parental use of antibiotics in children with URTIs leads to a better understanding of the causes if this overuse in Saudi Arabia and therefore addressing these factors with the appropriate intervention strategies.

Participants

1- Instrument development – Phase 1 (Delphi study):

The development of the instrument and the content and face validation were assessed using a content evaluation panel to build the group brainstorming process (Colton & Covert, 2007). The panel consisted of experts in fields of: paediatrics, infectious diseases, epidemiology, family medicine, psychology and counselling, and social sciences. Twenty experts were included in the study **(**Table 4.1**)**, 11 Saudi experts and 9 Australian experts. Half of the panellists were males.

Ethical clearances were obtained from the University of Dammam, Saudi Arabia (Ethical approval number: P2011013) and Queensland University of Technology in Australia (Ethical approval number: 1100001023). The panel members were approached via email independently to insure their anonymity. The panellists received background information about the study and a cover letter

explaining what is needed from them. Expert's reply to the questionnaire was considered their consent as explained to them in the cover letter.

Table 4.1 - Nationality and speciality of experts

Specialty	Nationality		**Total**
	Saudi	Australian	
Family Medicine	2	0	2
Paediatrics	3	0	3
Epidemiologist	4	1	5
Paediatric infectious disease	1	0	1
Psychology	0	6	6
Social sciences	0	1	1
Emergency	0	1	1
Quality specialist	1	0	1
Total	**11**	**9**	**20**

2- Instrument Development – Phase 2 (Pilot study):

Ethical approvals were obtained from Queensland University of Technology (Ethical approval number: 1200000022) and the Ministry of Education in the Eastern Province in Saudi Arabia (Ethical Approval Number: 33505889). Parents' consent was implied by the return of the completed questionnaire as stated in the questionnaire's cover page. Parents of children younger than 12 years old were recruited from primary schools in the Eastern Province, Saudi Arabia. Only questionnaires completed by a parent or a legal guardian was included in the study. 238 parents completed the questionnaire from March to April 2012.

3- Main data collection: for Instrument development phase 3 (Construct validation), Modeling study, and discovering the factors contributing to the parental use of antibiotics:

Participants in this study were used to conduct the Confirmatory Factor Analysis, Scales modeling using general linear models, and Discovering the factors influencing the parental use of antibiotics in children using ordinal logistic regression.

Confirmatory factor analysis and multivariable modelling consist of a large number of variables, and it is usually too complex to prospectively power. Little information is available on the sample size selection of such analyses. Therefore, we used 'Rules of thumb' to guide in the selection of sample size. The approach used in this study was advocated by Comrey and Lee (1992) where 100= fair, 200=good, 500= very good, and >1000= excellent (Comrey & Lee, 1992). Another approach was used to determine the regression sample size, this approach was promoted by Green (1991) (Green, 1991): $N > 50 + 8$ m (where m is the number of independent variables) for testing the multiple correlation. We inflated the sample size for the purpose of clustering effect. Furthermore, we were not sure if we would need to conduct subgroup analysis (e.g. mothers and fathers), therefore we were conservative in the selection of sample size. 1104 parents were included in the study (79% response rate).

4.3. DATA COLLECTION AND SAMPLING

1- Instrument development – Phase 1 (The Delphi study):

Using the Delphi technique, data from experts was collected to help in the instrument's development, by setting up a pool of questions and asking for experts' opinions in regards to the content's relevance to the intended study. The developed questions capture the underlying psychosocial constructs influencing parents' overuse of antibiotics in children with URTIs. This phase assessed the content and face validity of the instrument. Doctors were recruited using convenient sampling.

Instrument translation took place at this phase after assessing the content and face validation of the instrument. Brislin's (Brislin, 1986) model of translation was adapted to conduct the translation **(**Figure 4.3**)**. Steps for the translating the instrument from English to Arabic include:

1- Forward translation:

- **a.** Two bilingual translators translated the instrument, one was a health professional and the other one was an accredited translator.
- **b.** A panel of 4 persons reviewed the two versions of the translated questionnaires that were produced by the independent translators.
- **c.** The panel members agreed on best questionnaire using the two translated versions. The final Arabic version is now ready.

2- Back-translation:

- **a.** The final version of the Arabic questionnaire was sent to two independent translators, one health professional and one accredited translator.
- **b.** The panel reviewed the two versions of the back-translated version of the questionnaire. Final back-translated questionnaire is ready.

c. Finally, the research team compared the back-translated version of the questionnaire against the original one.

Please refer to **Chapter 5 for more details on this study.*

2- Instrument development – Phase 2 (Pilot study – EFA):

Parents were recruited from primary schools in the Eastern Province of Saudi Arabia to participate in the pilot study. Questionnaires were sent to the school where they were distributed to parents from March to April 2012. Only questionnaires completed by one of the parents or a guardian was included in the study. 238 parents completed the questionnaire (70% were mothers).

Please refer to **Chapter 6 for more details on this study.*

3- Main data collection: for Instrument development phase 3 (Construct validation), modelling study, and discovering the factors contributing to the parental use of antibiotics:

Data collected at this phase was used to conduct CFA, scales modeling, and factors influencing parental antibiotics use. Three independent analyses of the same data was conducted to do the three studies mentioned above, in this respect no bias should be introduced.

This is a cross-sectional study design using a preliminary-validated questionnaire (Alumran, et al., 2013a). Parents of children younger than 12 years old were recruited from primary schools parental meetings in the Eastern Province of Saudi Arabia between September 2012 and January 2013. Attendance at these parental meetings is considered a social obligation in Saudi Arabia, which provides

strong coverage of the entire cross-section of the community. This technique has some advantages, such as: diversity across the community, different schools for males and females in Saudi Arabia, and high participation rate.

4.4. SAMPLE DESCRIPTION:

Participants' consent was implied in the return of the completed questionnaire as shown in the questionnaire's cover page. 1111 completed questionnaires were returned. Only questionnaires completed by one of the parents or a legal guardian were included in the study, therefore 7 were excluded since they were completed by someone other than the parent or guardian. Therefore, only 1104 were included in the study (79% response rate). Table 4.2 shows the distribution of primary schools in the region, the number of children in the region, and the number of questionnaires distributed and collected from parents.

Table 4.2 - Distribution of schools in the study

Type of school	**Public**		**Private**		**Total**
	No. of schools	**No. of students /parents**	**No. of schools**	**No. of students**	
Total in the region	282**	87,471**	68**	18,327**	346 schools 105,628 students
Total approached	19	750	14	650	33 schools **1400 parents**
Total responded	19	562	14	542	33 schools **1104 parents**
				Total response rate	**79%**

Pictures from the data collection are available in **appendix C*

*** Information available from the statistical report from the ministry of education in the eastern province for the years 2010/2011.*

Parents' baseline characteristics are shown in Table 4.3 Fifty-two percent of the parents were mothers, and only 10% of the parents were trained in a health-field such as: medical, nursing, or paramedical. Parents' age was between 19 and 72 years (mean= 38, SD= 8). More than half of the parents were employed (57%), 24% were

housewives, 8% had a private business, and only 2% were unemployed. Most of the participants had a diploma or a bachelor degree (62%) while only 1% of the parents were illiterate. 44% of the parents said that they were originally from the Eastern Province, and 13% were non-Saudis. Most of the parents who were not originally from the Eastern Province reported that they moved to the Eastern Province in their adulthood (57%). The average reported monthly income is 4,000 to 11,9999 SR [AUD 1,000 - 2,999] showing 33% of the sample, followed by 12,000 to 21,999 SR [AUD 3,000 - 5,499] (32%).

Parents were asked about their child's health-related history. Only 39 (3.5%) parents reported that at least one of their children has had a serious infectious disease in the past, the reported infectious diseases include: chicken pox, flu (including swine flu), mumps and measles, and other infectious disease. parents also reported whether any of their children has a chronic disease, 141 (13%) of the children were reported to have a chronic disease, including: blood conditions (such as: Thalassemia and Anemia including Hemolytic anemia and Sickle cell anemia), allergies including skin allergies, diabetes, Glucose-6-phosphate dehydrogenase (G6PD) deficiency, and a few cases of heart diseases including arrhythmia.

The number of antibiotics used for the youngest child in the family during the past year was also collected in the questionnaire, as well as the number of cold episodes for the youngest child in the family in the past year. Table 4.4 shows the cross tabulation of these variables as well as the Pearson chi-square test.

Details on these studies are available in Chapters 7, 8, and 9.

Table 4.3 – Parents' baseline characteristics

Variable	Value	Freq.	%
Parent	Mother	574	51.99
	Father	530	48.01
	Total	**1101**	**100.0**
Health Trained	Yes	115	10.42
	No	989	89.58
	Total	**1104**	**100.0**
Employment	Employed	632	57.35
	Unemployed	21	1.91
	Student	10	0.91
	Housewife	313	28.40
	Private Business	90	8.17
	Retired	36	3.27
	Total	**1102**	**99.8**
Education	Illiterate	11	1.0
	No Formal Certificate	30	2.74
	Intermediate School Certificate	54	4.93
	High School Certificate	212	19.34
	Diploma or Bachelor	687	62.68
	Higher Degree	102	9.31
	Total	**1096**	**99.3**
Geographical background	Eastern Province	485	44.25
	Western Province	83	7.57
	Central Province	164	14.96
	Northern Province	40	3.65
	Southern Province	185	16.88
	Non-Saudi	139	12.68
	Total	**1096**	**99.3**
Move to eastern province	Childhood	212	20.00
	Adolescent	40	3.77
	Adulthood	340	30.08
	NA	468	42.15
	Total	**1060**	**96.0**
Monthly income	< 4000 SR (<AUD 1000)	109	9.8
	4000 - 11,999 SR (AUD 1,000 - 2,999)	371	33.4
	12,000 - 21,999 SR (AUD 3,000 - 5,499)	356	32.0
	22,000 - 34,999 SR (AUD 5,500 - 8,799)	168	15.1
	>35,000 SR (>8,800)	62	5.6
	Total	**1066**	**95.9**
Age		Mean= 38	SD= 8

*All values are presented in frequencies and percentages unless stated otherwise

Table 4.4 – Cross-tabulation of the frequency of antibiotics use and common cold episodes for the youngest child in the family in the past year

		Antibiotic Use					
		Never	Once a year	2 - 3 times/yr	4 - 6 times/yr	> 6 times/yr	**Total**
Cold Episodes	Never	46	7	9	0	0	**61**
	Once a year	47	156	43	8	3	**257**
	2 - 3 times/yr	38	122	364	44	7	**575**
	4 - 6 times/yr	2	6	54	64	13	**139**
	> 6 times/yr	0	1	5	12	30	**48**
	Total	**133**	**292**	**474**	**128**	**53**	**1080**
Pearson chi2(16) = 1.0e+03 P < 0.0001							

4.5. INSTRUMENT

The Parental Perceptions on Antibiotics (PAPA) Scales was developed (Alumran, et al., 2013b), preliminary validated (Alumran, et al., 2013a), and fully validated (alumran, CFA) in this study. The PAPA instrument consists of 33 items that measure the psychosocial factors influencing the parental use of antibiotics in children with URTIs (Cronbach's $\alpha = 0.78$). The items were rated on a 5-point Likert scale ranging from *strongly disagree* to *strongly agree*, and from *never* to *always*. Also, parents' demographic characteristics are collected as well as child health-related history.

The scales in the instrument that measure the parental psycho-social factors are:

1- Knowledge and beliefs [KB] consists of 10 items, for this scale a higher score means better knowledge and beliefs about the appropriate use of antibiotics in

children with URTIs. This construct shows good internal consistency in this sample (Cronbach's α= 0.836). Items in this scale include:

- [KB1] Antibiotics are needed for: the common cold
- [KB2] Antibiotics are needed for: Sore throat
- [KB3] Antibiotics treat viral infections
- [KB4] Antibiotics can cure **ALL** types of infections (viral, bacterial, & fungal)
- [KB5] Antibiotics are helpful in treating common cold among children
- [KB6] My child will be sick for a longer time if he/she doesn't receive an antibiotic for cough, cold, or flu symptoms
- [KB7] If my child has a cold or cough it is best to get an antibiotic to get rid of it.
- [KB9] In the past Antibiotics have cured my child's cold symptoms,
- [KB10] when I visit the doctor for my child's common cold I expect prescription for medication including antibiotics

2- Behaviors [B] consists of 5 items, for this scale a higher score means better behavior regarding antibiotics use. This construct shows good internal consistency in this sample (α= 0.771). Items in this scale are:

- [B1] I get my child's antibiotics from the pharmacy without a prescription
- [B2] I generally store antibiotics at home for when they are needed
- [B3] In the past, I have given my child an antibiotic without a prescription when he/she had a high temperature for a few days
- [B4] In the past, I have stopped giving my child an antibiotic because my friends/family advised me to

- [B5] In the past, I have changed doctors when my doctor did not prescribe antibiotics for my child

3- Antibiotics Adherence [AD] consists of 5 items, in this scale a higher score in this scale means better adherence to appropriate antibiotic doses. This construct shows good internal consistency in this sample (Cronbach's α= 0.765). Items in this scale are:

- [AD1] Skipping one or two antibiotic doses doesn't make much difference
- [AD2] If my child gets better I can reduce the dose of antibiotics
- [AD3] If my child's condition is mild I would give the antibiotic according what I see is suitable for to his/her condition
- [AD4] In the past, I have stopped giving my child an antibiotic because he/she felt better
- [AD5] It is not important to follow antibiotics doses strictly

4- Seeking Information [SI] consists of 7 items; in this scale a higher score means more information seeking. This construct is measured using 7 items. The Seeking information scale shows good internal consistency in this sample (Cronbach's α= 0.834). Items in this scale are:

- [SI1] I get my health-related information from nurses and/or other allied health professionals
- [SI2] I get my health-related information from books and/or scientific literature
- [SI3] I get my health-related information from family and/or friends
- [SI4] I get my health-related information from the internet

- [SI5] I get my health-related information from the media: TV, Radio, newspapers
- [SI6] I get my health-related information from my previous experience
- [SI7] I get my health-related information from the pharmacist

5- Awareness about Antibiotics Resistance [ABR] consists of 4 items, in this scale a higher score means better awareness regarding antibiotics resistance. The internal consistency in this sample for this construct appears to be moderate (Cronbach's α= 0.462). Items in this scale are:

- [ABR1] Antibiotics can be harmful to one's health
- [ABR2] Some germs are becoming harder to treat with antibiotics
- [ABR3] Some germs can become resistant to antibiotics if they are taken in inadequate doses
- [ABR4] Antibiotics treat bacterial infections

Please refer to **appendix A for Arabic version of the instrument*

Please refer to **appendix B for English version of the instrument*

4.6. ANALYSIS

All analysis was conducted using the Statistics Package for Social Sciences (SPSS v19: (IBM, 2010)), R statistics package (v2.14.2) for the parallel analysis using the nFactor library (v2.3.3), AMOS (Arbuckle, 2006) for Confirmatory Factor Analysis (CFA), and Stata/SE v12 (Stata, 2011) for CFA and modelling. Throughout all analyses a statistical significance level of 0.05 (i.e. $\alpha = 0.05$) will be used.

1. Instrument development

Phase 1 (Delphi study)

This study included a qualitative component, which was conducted using a Delphi technique. At this stage content validity and face validity of the instrument were assessed on a 3-round iterative process using experts feedback in regards to the instrument's content and flow.

Phase 2 (Pilot study – EFA)

This was a multivariate analysis; therefore missing values were excluded listwise. Exploratory factor analysis was conducted using parallel analysis based on Principal Component Analysis. The number of factors was chosen on a theoretical basis as well as scree plots and Kaiser Criteria (Eigen value > 1). The nature of the underlying factors was determined by using the Principal Axis Factoring (Colton & Covert, 2007). As for the rotation on the factor solution, both an Orthogonal (Varimax) and an Oblique (Promax) Rotation were performed to determine which rotation was most suitable. The instrument's reliability (internal consistency) was evaluated using Cronbach's alpha.

Phase 3 (Full validation)

Confirmatory factor analysis of the instrument was conducted using AMOS and Stata/SE v12. The model fit was done using Generalized Least Squares. Summary statistics that were used to evaluate the model fit are the Goodness of Fit Index (GFI; (Tabachnick & Fidell, 2013)), Root Mean Square Error of Approximations (RMSEA; (Browne & Cudeck, 1993)), and the raw and modified χ^2 fit statistics. A GFI greater than 0.9 is considered a good fit (Byrne, 1994). The RMSEA value of

less than 0.06 suggests a good model fit (Browne & Cudeck, 1993; Hooper, Coughlan, & Mullen, 2008).

Little's MCAR test (Little, 1988) was done to check if missing values were missing completely at random. Missing values were imputed using Expectation Maximization Technique (Tabachnick & Fidell, 2013). The internal consistency of the instrument (PAPA scales) was assessed using Cronbach's alpha.

Convergent validity was evaluated by calculating the Average Variance Extracted (AVE) for each construct, and then the AVE was evaluated against its correlation with other constructs. Convergent validity is achieved when AVE is larger than the construct's correlation with other constructs (Gefen, Straub, & Boudreau, 2000). Discriminnt validity was evaluated by measuring the Maximum Shared Variance (MSV) and the Average Shared Squared Variance (ASV), Discriminant validity is achieved when both MSV and ASV are lower than AVE for all constructs (Hair, Black, Babin, & Anderson, 2010).

2. Scales modeling:

The number of antibiotics used for the youngest child in the family in the last year was evaluated against the parents' demographic variables, child health-related history, and the scales measuring parents' psychosocial factors influencing the use of antibiotics.

General linear models (simple linear regression) were produced for each outcome variable in this study using purposeful selection of covariates (Hosmer, Lemeshow, & May, 2008). The outcome variables are the scales in the instrument: (1) knowledge and beliefs, (2) behaviors, (3) Antibiotics Adherence, (4) Seeking Information, and (5) Awareness about antibiotics resistance. Models adequacy were evaluated by

assessing the each model's fit using the adjusted R^2 and significance using the F-test. Models assumptions were also evaluated by assessing the residuals of each model if they were normally distributed around zero with a constant variance.

3. Factors influencing the parental use of antibiotics:

The instrument's scales are: parents' knowledge and beliefs about the appropriate use of antibiotics, parental behaviours in regards to the appropriate use of antibiotics in children, parental adherence to the appropriate antibiotic doses, parental eagerness to seek health-related information, and parents awareness about antibiotics resistance.

The instrument's scales were evaluated against a set of covariates, including: (1) parent's demographic variables: gender of the parent, number of girls and boys in the family, parents health-related training, parent's age, parents employment status, parent's education level, parent's geographical background, when the parent moved to the Eastern Province, and parent's monthly income; and (2) child's health-history information: number of cold episodes for the youngest child during the last year, and whether any of the children in the family has ever had a serious infectious disease and/or a chronic disease.

Ordinal logistic regression was used to discover the factors influencing the parental use of antibiotics in children. The number of antibiotics used was compared against the psychosocial factors and other factors in the instrument.

**Please refer to appendix D for means of scales in the instrument in comparison with the prevalence of parental usage of antibiotics in children.*

4.7. ETHICAL CONSIDERATIONS

The required ethical approvals were obtained for all of the studies conducted:

Study	Saudi Arabia	Australia
Instrument development	University of Dammam: P2011013	QUT: 1100001023
Pilot study	Department of Development and Planning in the Ministry of Education in the Eastern Province: 33505889	QUT: 1200000022
Main study	Department of Development and Planning in the Ministry of Education in the Eastern Province: 33505889	QUT: 1200000022

Chapter 5: Instrument Development (Phase 1)

Title: Assessing the Overuse of Antibiotics in Children with URTIs in Saudi Arabia: Development of the Parental Perception on Antibiotics Scale (PAPA Scale)

Citation: Alumran, Arwa, Hou, Xiang-Yu, & Hurst, Cameron. (2013). Assessing the overuse of antibiotics in children with URTIs in Saudi Arabia: Development of the parental perception on antibiotics scale (PAPA scale). *Journal of Epidemiology and Global Health*. doi: 10.1016/j.jegh.2012.11.005

Date submitted: 27 Feb 2012

Date Accepted: 27 Nov 2012

Contribution of authors:

The candidate designed the study and performed data collection and analysis. The manuscript was written by the candidate, and reviewed by the rest of the authors. All authors provided valuable input on the initial draft of the manuscript.

Summary of the results:

A content evaluation panel was formed to assess in the development of the instrument's content. The panel was composed of experts knowledgeable in the areas of: pediatrics, infectious diseases, epidemiology, family medicine, psychology and counseling, and social sciences. The Delphi Technique was used to collect information from the experts, by

providing the panel with the questionnaires iteratively on a 3-round basis until consensus was reached. The final round produced 58 items (including demographics information). Further, comments and suggestions about the instrument's content were obtained from the panel members throughout the data collection process. Content validation of the instrument was achieved through this study. Then, translation was performed on the instrument by adapting Brislin's model of translation and a final Arabic version of the instrument was produced from the translation process. The instrument needs to undergo further validation steps, such as construct validity.

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Statement of Contribution of Co-Authors for Thesis by Published Paper

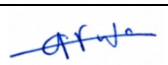
The following is the format for the required declaration provided at the start of any thesis chapter which includes a co-authored publication.

The authors listed below have certified* that:

1. they meet the criteria for authorship in that they have participated in the conception, execution, or interpretation, of at least that part of the publication in their field of expertise;
2. they take public responsibility for their part of the publication, except for the responsible author who accepts overall responsibility for the publication;
3. there are no other authors of the publication according to these criteria;
4. potential conflicts of interest have been disclosed to (a) granting bodies, (b) the editor or publisher of journals or other publications, and (c) the head of the responsible academic unit, and
5. they agree to the use of the publication in the student's thesis and its publication on the QUT ePrints database consistent with any limitations set by publisher requirements.

In the case of this chapter:

Publication title and date of publication or status: Assessing the Overuse of Antibiotics in Children with URTIs in Saudi Arabia: Development of the Parental Perception on Antibiotics Scale (PAPA Scale)

Contributor	Statement of contribution*
Arwa Alumran  30/10/2013	Designed the study and performed data collection and analysis. Wrote the manuscript. Provided valuable input on the initial draft of the manuscript.
Xiang-Yu Hou	Provided feedback and valuable input on the initial draft of the manuscript.
Cameron Hurst	Provided feedback and valuable input on the initial draft of the manuscript.

Principal Supervisor Confirmation

I have sighted email or other correspondence from all Co-authors confirming their certifying authorship.

Xiang-Yu Hou		13/11/2013
Name	Signature	Date

Chapter 6: Instrument Development (Phase 2)

Title: Assessing the overuse of antibiotics in children in Saudi Arabia: validation of the parental perception on antibiotics scale (PAPA scales)

Citation: Alumran, Arwa, Hou, Xiang-Yu, & Hurst, Cameron. (2013). Assessing the overuse of antibiotics in children in Saudi Arabia: validation of the parental perception on antibiotics scale (PAPA scale). *Health and Quality of Life Outcomes, 11*(1), 39.

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Date accepted: 4 March 2013

Contribution of authors:

The candidate designed the study and performed data collection and analysis, with the assistance of CH. The manuscript was written by the candidate, and reviewed by the rest of the authors. CH and JH provided valuable input on the initial draft of the manuscript.

Summary of the results:

After collecting information from parents of children younger than 12 years old in Saudi Arabia using the PAPA instrument, parallel analysis and Exploratory factor analysis using principal axis factoring was conducted to discover the number and nature of factors in the instrument. The analysis produced six factors: knowledge and beliefs, behaviors, sources

of information, adherence, awareness about resistance, and parents' perception regarding doctors' prescribing behaviors. After assessing the instrument's reliability, the results demonstrated a reliable instrument (Cronbach' s alpha = 0.78). This is the first study that constructively validates the psychosocial factors influencing the parental use of antibiotics. The instrument needs to undergo further validation.

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Statement of Contribution of Co-Authors for Thesis by Published Paper

The following is the format for the required declaration provided at the start of any thesis chapter which includes a co-authored publication.

The authors listed below have certified* that:

1. they meet the criteria for authorship in that they have participated in the conception, execution, or interpretation, of at least that part of the publication in their field of expertise;
2. they take public responsibility for their part of the publication, except for the responsible author who accepts overall responsibility for the publication;
3. there are no other authors of the publication according to these criteria;
4. potential conflicts of interest have been disclosed to (a) granting bodies, (b) the editor or publisher of journals or other publications, and (c) the head of the responsible academic unit, and
5. they agree to the use of the publication in the student's thesis and its publication on the QUT ePrints database consistent with any limitations set by publisher requirements.

In the case of this chapter:

Publication title and date of publication or status: Assessing the overuse of antibiotics in children in Saudi Arabia: validation of the parental perception on antibiotics scale (PAPA scales)

Contributor	Statement of contribution*
Arwa Alumran  30/10/2013	Designed the study and performed data collection and analysis. Wrote the manuscript.
Xiang-Yu Hou	Provided feedback and valuable input on the initial draft of the manuscript.
Cameron Hurst	Assisted in the data analysis Provided feedback and valuable input on the initial draft of the manuscript.

Principal Supervisor Confirmation

I have sighted email or other correspondence from all Co-authors confirming their certifying authorship.

Xiang-Yu Hou		13/11/2013
Name	Signature	Date

HEALTH AND QUALITY OF LIFE OUTCOMES

RESEARCH Open Access

Assessing the overuse of antibiotics in children in Saudi Arabia: validation of the parental perception on antibiotics scale (PAPA scale)

Arwa Alumran[1,2,3*], Xiang-Yu Hou[1,2] and Cameron Hurst[1,2]

Abstract

Background: Antibiotics overuse is a global public health issue influenced by several factors, of which some are parent-related psychosocial factors that can only be measured using valid and reliable psychosocial measurement instruments. The PAPA scale was developed to measure these factors and the content validity of this instrument was assessed.

Aim: This study further validated the recently developed instrument in terms of (1) face validity and (2) construct validity including: deciding the number and nature of factors, and item selection.

Methods: Questionnaires were self-administered to parents of children between the ages of 0 and 12 years old. Parents were conveniently recruited from schools' parental meetings in the Eastern Province, Saudi Arabia. Face validity was assessed with regards to questionnaire clarity and unambiguity. Construct validity and item selection processes were conducted using Exploratory factor analysis.

Results: Parallel analysis and Exploratory factor analysis using principal axis factoring produced six factors in the developed instrument: knowledge and beliefs, behaviours, sources of information, adherence, awareness about antibiotics resistance, and parents' perception regarding doctors' prescribing behaviours. Reliability was assessed (Cronbach's alpha = 0.78) which demonstrates the instrument as being reliable.

Conclusion: The 'factors' produced in this study coincide with the constructs contextually identified in the development phase of other instruments used to study antibiotic use. However, no other study considering perceptions of antibiotic use had gone beyond content validation of such instruments. This study is the first to constructively validate the factors underlying perceptions regarding antibiotic use in any population and in parents in particular.

Keywords: Antibiotics overuse, Psychosocial, Measurement instrument, Reliability, Validity, Exploratory factor analysis, Saudi Arabia

Introduction

Although antibiotics are targeted to kill or inhibit the growth of bacteria and have no effect on viral agents [1], they are often inappropriately used to treat viral infections such as upper respiratory tract infections (URTIs). URTIs are usually self-limiting and resolve in the same amount of time regardless of antibiotic consumption [2]. Thus, using antibiotics to treat these viral infections is considered misuse or overuse of antibiotics. This misuse/overuse is common in children [3,4], and is currently considered to be one of the major worldwide public health issues [5-7].

Antibiotics misuse/overuse may cause several problems, for instance: development of antibacterial resistance [8,9], increasing the burden of chronic diseases and rising costs of health services [10], and the development of side effects (e.g. adverse gastrointestinal effects) [11]. These adverse effects are more significant in children according to Simasek [12].

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Table 1 Demographic characteristics of study participants

Variable	Mothers N = 167 (%)	Father N = 70 (%)	Total N = 237 (%)
Age			
20 – 30	22 (13.2)	0 (0)	22 (9.3)
31 – 40	86 (51.5)	20 (28.6)	106 (44.7)
41 – 50	36 (21.6)	31 (44.3)	67 (28.3)
>50	0 (0)	15 (21.4)	15 (6.3)
Missing	23 (13.8)	4 (5.7)	27 (11.4)
No. of children*			
1 child	43 (26.1)	20 (8.6)	63 (27.0)
2 children	49 (29.7)	19 (8.2)	68 (29.2)
3 children	57 (34.5)	17 (7.3)	74 (31.8)
4 children	11 (6.7)	8 (3.4)	19 (8.2)
5 children	5 (3.0)	4 (1.7)	9 (3.9)
Missing	2 (1.2)	2 (2.9)	4 (1.7)
Educational level			
Illiterate	2 (1.2)	0 (0)	2 (0.9)
No formal education	2 (1.2)	0 (0)	2 (0.9)
Junior high school	7 (4.2)	7 (10.1)	14 (6.0)
High school	26 (15.8)	6 (8.7)	32 (13.7)
Diploma or bachelor	125 (75.8)	38 (55.1)	163 (13.7)
Higher degrees	3 (1.8)	18 (26.1)	21 (9.0)
Missing	2 (1.2)	1 (1.4)	3 (1.3)
Employment			
Unemployed	3 (1.8)	2 (2.9)	5 (2.1)
Employed	91 (55.5)	55 (78.6)	146 (62.4)
Student	6 (3.7)	0 (0)	6 (2.6)
Housewife	56 (34.1)	0 (0)	56 (23.9)
Self-employed	5 (3.0)	7 (10.0)	12 (5.1)
Retired	3 (1.8)	6 (8.6)	9 (3.8)
Missing	3 (1.8)	0 (0)	3 (1.3)
Monthly income**			
Low	12 (8.0)	9 (13.8)	21 (9.8)
Low middle	53 (35.3)	20 (30.8)	73 (34.0)
Middle	54 (36.0)	16 (24.6)	70 (32.6)
High middle	19 (12.7)	12 (18.5)	31 (14.4)
High	12 (8.0)	8 (12.3)	20 (9.3)
Missing	17 (10.2)	5 (7.1)	22 (9.3)
Trained in health-related fields			
Yes	27 (16.5)	10 (14.7)	37 (15.9)
No	137 (83.5)	58 (85.3)	195 (84.1)
Missing	3 (1.8)	2 (2.9)	5 (2.1)
Geographical background			
Eastern region	91 (59.5)	34 (55.7)	125 (58.4)
Western region	13 (8.5)	7 (11.5)	20 (9.3)
Middle region	23 (15.0)	10 (16.4)	33 (15.4)
Northern region	2 (1.3)	3 (4.9)	5 (2.3)
Southern region	24 (15.7)	7 (11.5)	31 (14.5)
Missing	14 (8.4)	9 (12.9)	23 (9.7)

*Children less than 12 years old.
** Income: low: <SR4000 (<$1066), Low middle: SR4000-11,999 ($1,066-3,199), Middle: SR12,000–21,999 ($3,199–5,866), High middle: SR22,000–34,999 ($5,866–9,332), High: > SR35,000 (> $9332).

This misuse may be due to reasons related to: patients, parents or guardians, or the medical practitioner. Several studies have discussed the reasons associated with antibiotics overuse. These include: attitudes, beliefs, knowledge of antibiotic use [13-15], behaviours (e.g. over-the-counter medication and self-medication) [5,16,17], patients' perceptions regarding patient-doctor interaction, patient satisfaction, and patients' experience with antibiotics [15,18]. These studies have provided a framework for the development of the Parental Perception on Antibiotics Scale –'The PAPA Scale' [19].

The behaviours associated with the overuse of antibiotics may include antibiotics self-medication and over-the-counter medication. These behaviours specifically are considered a public health issue in many middle-east countries that are similar to Saudi Arabia, geographically and culturally [13,16,17,20]. However, information regarding trends in antibiotic consumption in Saudi Arabia is very limited. Moreover, there are no reports on parents' behaviours regarding antibiotics use among Saudi children, especially those with upper respiratory tract infections (URTIs) [21]. As a result, it is important to measure this psychosocial phenomenon in Saudi Arabia.

In order to measure such psychosocial phenomena, a valid and reliable measurement instrument needs to be available [22]. Assessing the validity of an instrument involves confirming the instrument's capability of measuring what it is intended to measure [23]. However, an extensive literature review has not revealed any validated instrument worldwide that measures the factors influencing antibiotics overuse in children with URTIs [24]. This study aims to validate a developed and content-validated instrument [19]; further validation includes construct validity of the instrument using factor analysis, which will determine the number and nature of the underlying construct in the developed instrument.

Methods

This was a cross-sectional study design using a preliminary-validated questionnaire [19]. The required ethical approvals were obtained from Queensland University of Technology (ethical approval number: 1200000022) and the Ministry of Education in the Eastern Province in Saudi Arabia (ethical approval number: 33505889). The questionnaire was distributed to parents of children (younger than 12 years old) in primary schools in the Eastern Province of Saudi Arabia between March to April 2012. Participants' consent was implied by the return of the completed questionnaire.

Only questionnaires completed by one of the parents or a legal guardian were included in the study. One questionnaire was excluded because it was completed by a sibling who was less than 18 years old.

Instrument development

The PAPA scale was developed to assess parental perceptions regarding antibiotics. This scale aims to assess the factors influencing parents to use antibiotics for their children, especially in relation to upper respiratory tract infections. A content evaluation panel was developed to assess the content and face validity of the instrument by building a group brainstorming process [25]. The scale items were firstly derived from relevant literature in the field. This was followed by a three-round Delphi process conducted using a panel of experts knowledgeable in such areas as pediatrics, infectious diseases, epidemiology, family medicine, psychology and counseling, and social sciences. The report of this study has been published elsewhere [19].

Experts were provided with a pool of 80 questions retrieved from the relevant literature [18,26-29]. They were asked to choose the most relevant questions to measure the study objectives; i.e. factors influencing the overuse of antibiotics in children with URTIs in Saudi Arabia for the first round. Experts were also invited to generate ideas in this round [30]. The included questions from the first round were then sent again to the same panel members with the percentage of agreement for each item [31]. In this second round, experts were asked to agree, disagree, and/or comment on the items. The third and last round was sent to the experts to obtain their final confirmation on the instrument. The development process involved face validity as well as content validation. Face validity was conducted by asking the experts to comment on the clarity and flow of the questions in the proposed questionnaire.

A 58-question content-validated survey was developed to conduct this study [19]. The first part of the questionnaire, which is not the focus of this study, dealt with parental demographics and children's health-related history.

Table 2 Children's health-related history according to their parents

Common cold episodes/year	Antibiotic usage/year				
	Never	Once	2 - 3 times	4–6 times	> 6 times
Never	**7**	0	0	0	0
Once	7	**23**	12	2	0
2–3 times	13	24	**65**	9	1
4–6 times	2	6	12	**33**	4
> 6 times	0	0	3	2	**10**

Total = 235 (3 missing values).

The second part consisted of questions about the factors associated with antibiotics use, e.g. parental knowledge, behaviours, attitudes and beliefs about antibiotics use for children younger than 12 years of age. The last part was to assess the face validity of the questionnaire. All questions relating to antibiotics use were measured on a five-point Likert scale. Questions to assess the face validity of the questionnaire were on Binary scale (yes/no).

Statistical analysis

Personal characteristics were summarised using frequencies and percentages. The association of antibiotics use per year with the frequency of common cold episodes per year was assessed using cross tabulation.

Parallel analysis based on Principal Components Analysis was conducted; scree plots and Kaiser Criteria (Eigen value > 1) were used along a theoretical basis for choosing the number of factors. As this is a multivariate analysis, missing values were excluded listwise from the list.

Following the parallel analysis, Principal axis factoring was used to determine the nature of the underlying factors [25]. Both an orthogonal (Varimax) and an oblique

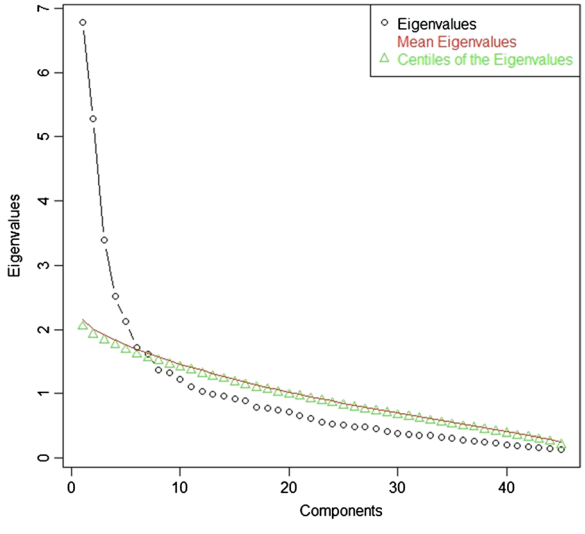

Figure 1 Parallel Analysis derived from a principal component analysis.

Table 3 The pattern coefficients from a principal axis factoring using promax rotation

Factors and items	Items loadings
Factor 1: Knowledge and beliefs	
1- Antibiotics are needed for: the common cold	.627
2- Antibiotics are needed for: sore throat	.631
3- Antibiotics treat viral infections	.461
4- Antibiotics can cure ALL types of infections (viral, bacterial, & fungal)	.574
5- When I visit the doctor for my child's common cold I expect a prescription for medication including antibiotics	.594
6- Antibiotics are helpful in treating common colds among children	.687
7- Children with common colds get better faster when antibiotics are given	.749
8- In the past, antibiotics have cured my child's cold symptoms	.628
9- My child will be sick for a longer time if he/she doesn't receive an antibiotic for cough, cold, or flu symptoms.	.613
10- If my child has a cold or cough it is best to get an antibiotic to get rid of it	.672
Factor 2: Behaviours:	
11- Antibiotics should be sold without a prescription	443
12- In the past, I have stopped giving my child an antibiotic because my friends/family advised me to	.426
13- I get my child's antibiotics from the pharmacy without a prescription	.809
14- I generally store antibiotics at home for when they are needed	.534
15- In the past, I have given my child an antibiotic without a prescription when he/she had a high temperature for a few days	.874
16- In the past, I have changed doctors when my doctor did not prescribe antibiotics for my child	.623
Factor 3: Sources of information:	
17- I get my health-related information from the pharmacist	.479
18- I get my health-related information from nurses and/or other allied health professionals	.472
19- I get my health-related information from books and/or scientific literature	.759
20- I get my health-related information from family and/or friends	.621
21- I get my health-related information from the internet	.773
22- I get my health-related information from the media: TV, radio, newspapers	.789
23- I get my health-related information from my previous experience	.556
Factor 4: Adherence:	
24- It is not important to follow antibiotics doses strictly	.465
25- Skipping one or two antibiotic doses doesn't make much difference	.716
26- If my child gets better I can reduce the dose of antibiotics	.902
27- If my child's condition is mild I would give the antibiotic according what I see is suitable for his/her condition	.517
28- In the past, I have stopped giving my child an antibiotic because he/she felt better	.697
Factor 5: Awareness about antibiotics resistance	
29- Antibiotics treat bacterial infections	.446
30- Antibiotics are generally safe	-.422
31- Antibiotics can be harmful to one's health	.444
32- Some germs are becoming harder to treat with antibiotics	.446
33- Some germs can become resistant to antibiotics if they are taken in inadequate doses	.674
Factor 6: Parent's perception on doctors' prescribing behaviors	
34- I think doctors prescribe too many antibiotics	.441
35- Doctors don't inform parents well about their child's condition	.622
36- Doctors aren't well informed about judicious antibiotics use	.674

Table 3 The pattern coefficients from a principal axis factoring using promax rotation *(Continued)*

Items excluded due to only trivial loadings on all factors (coefficient < 0.4):

37- Antibiotics are needed for: ear infection

38- If my child is asleep I will not wake him/her up for the dose of antibiotic

39- In the past, I have stopped giving my child an antibiotic because he/she had side effects

40- In the past, I have taken my child to a doctor when he/she had a high temperature for a few days

41- I get my child's antibiotics from the pharmacy with a prescription

42- In the past, I have asked the doctor to prescribe medication for my child's common cold

43- I get my health-related information from my doctor

44- When I visit the doctor for my child's common cold and do not get antibiotics, I get dissatisfied

45- Frequency of antibiotic use does not influence its effectiveness

The likely construct associated with each factor is also included.

(Promax) rotation were performed on the factor solution to determine which type of rotation was most suitable. The internal consistency of the instrument (i.e. reliability) was measured using Cronbach's alpha.

All data analysis was conducted using the Statistics Package for Social Sciences (SPSS v19) with the exception of the parallel analysis, which used the *nFactor* library (v2.3.3) within the R statistics package (v2.14.2).

Results

The questionnaires were completed by 238 parents (25% response rate). Mothers were more responsive than fathers; 70 percent of the parents in the study are mothers. Parents' personal characteristics are summarised in Table 1. Some demographic differences were noticeable between mothers and fathers in the sample. With regard to age, the average age category of mothers in the study appears to be 31-40 years old (52%), while fathers tend to fall within the age category of 41-50 years old (44%). Most mothers and fathers are employed (56% and 79% consecutively), and third of mothers are housewives (34%). Moreover, illiteracy is more observable in mothers (2%), while all fathers in the study are literate. The majority of mothers and fathers have a diploma or a bachelor degree (76% and 55% consecutively). However, only 2 percent of mothers have higher degrees, compared to 26 percent of fathers.

Parents were asked to assess their child's health-related history in relation to the number of common cold episodes per year and the number of antibiotic use per year (see Table 2). According to the parents, 13 (5.5%) children in the study had a serious infectious disease in the past including chicken pox and unidentified respiratory infections. Thirty-two (13.4%) children had chronic diseases such as heart disease, diabetes, asthma, and allergies.

Parallel analysis was performed to decide on the number of factors to retain in the Parental Perception on Antibiotics Scale (PAPA Scale). Based on a 10,000-permutations parallel analysis, a six-factor solution was produced (Figure 1).

According to the parallel analysis, a six-factor solution was used. The coefficients in the pattern matrix in Table 3 show the number and nature of factors in the PAPA Scale using Exploratory factor analysis. The produced factors include: Factor 1: knowledge and beliefs (10 items), Factor 2: behaviours (6 items), Factor 3: sources of information (7 items), Factor 4: adherence (5 items), Factor 5: awareness about antibiotics resistance (5 items), and Factor 6: parents' perception on doctors' prescribing behaviours (3 items). In addition, the inter-factor correlation matrix shown in Table 4 suggests that at least some of the factors are moderately correlated indicating that an oblique measurement model is justified.

By assessing the Instrument's reliability it was found that the total and sub-scales were demonstrated as being reliable with the overall Cronbach's alpha = 0.87, and the individual subscales Cronbach's alphas ranging from 0.771 to 0.794.

Discussion

After conducting parallel analysis and factor analysis to the newly developed and content validated measurement instrument, the following factors emerged from the analysis: knowledge and beliefs, behaviours, sources

Table 4 Inter-factor correlation matrix

Factor	1	2	3	4	5	6
1	1.000	.038	-.058	.171	.010	-.078
2	.038	1.000	.113	.535	-.403	-.098
3	-.058	.113	1.000	.127	-.189	.192
4	.171	**.535**	.127	1.000	-.473	.104
5	.010	**-.403**	-.189	**-.473**	1.000	-.017
6	-.078	-.098	.192	.104	-.017	1.000

Extraction method: principal axis factoring.
Rotation method: promax rotation with Kaiser normalization.

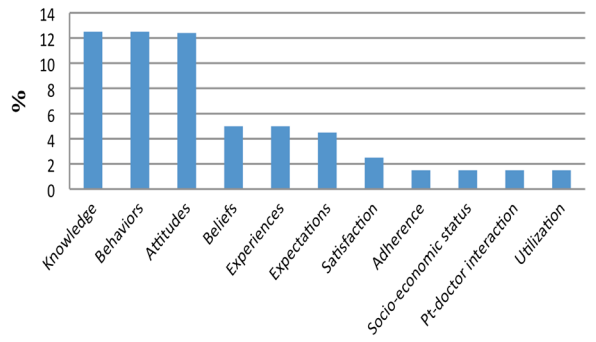

Figure 2 The frequency distribution of the dimensions mentioned in the literature.

of information, adherence, awareness about antibiotics resistance, and parents' perception on doctors' prescribing behaviours.

The influencing factors on the overuse of antibiotics include psychosocial factors such as attitudes and beliefs; knowledge-related factors that may lead to unwanted behaviours such as parents' pressure and inappropriate use of antibiotics; and demographic factors including education levels, socioeconomic status, and employment.

The constructs measured in the literature in the field of antibiotics use include: attitudes, beliefs, knowledge (including experience with antibiotics), and behaviours (over-the-counter medication and self-medication) [5,13,16,17,20,32-35]. Other factors are measured within these major dimensions including: patient expectations and adherence to antibiotics, patients' perceptions regarding patient-doctor interaction, and patient satisfaction [15,18,36,37]. Demographic characteristics were also measured in the reviewed literature relating to antibiotics use including: age, gender, level of education, and socio-economic status. Figure 2 shows the frequency of the dimensions reviewed in other studies that were conducted to measure the use of antibiotics. Thus, according to the dimensions available in previous studies and the dimensions present from this study, a conceptual model was created to show the relationship between the factors underlying antibiotics use/overuse (Figure 3).

Further psychometric testing is needed to determine the construct, concurrent, discriminate, and predictive validity of the PAPA scale. Moreover, the developed instrument can now be used in future research by translating it and culturally adapting it to different communities. In psychosocial research, instruments are frequently translated and cultural adapted to fit the population at hand [38]. Most instruments are developed in English. Therefore, for non-English speaking populations that are significantly different from the population used to develop the instrument, researchers usually translate and culturally adapt the English instrument to fit the local population [38]. Translation usually is a more efficient key for the scarcity of available instruments.

The PAPA scale produces a valid and reliable measurement instrument that can be used to assess parental perceptions regarding antibiotics. Since antibiotics overuse [3,4] and antibiotics resistance are global public health issues [8,9], many studies are targeted to minimise this problem. The PAPA scale could be effective in cross-sectional studies that aim to reduce the overuse of antibiotics in a community, starting by understanding the reasons behind this overuse. This, in turn, could inform the development of interventions directed to minimise the overuse of antibiotics.

Limitations

The survey was distributed within primary schools in order to capture a more generalised cross-section of the

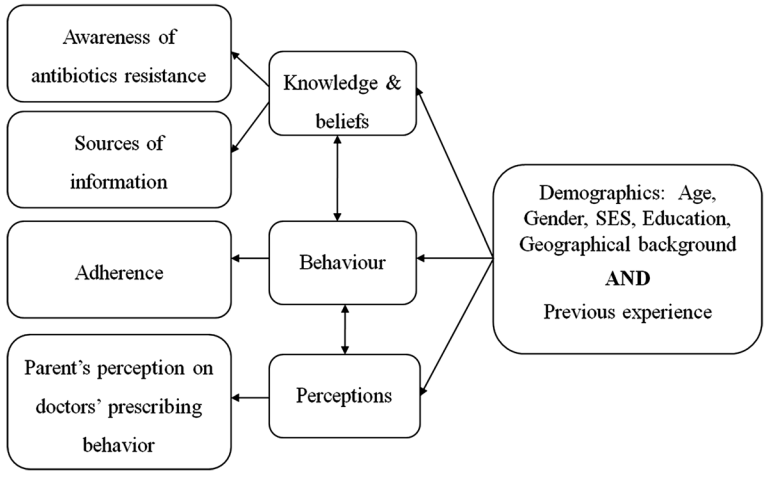

Figure 3 Conceptual framework.

community. However, since kindergartens are scarce in Saudi Arabia and not mandatory like primary, secondary, and high schools, parents of children under the age of six are not represented in such a sample unless there is more than one child in the household. Consequently, this could be considered a source of bias [39]. Also, another limitation is the low response rate which may raise concerns about selection bias.

Conclusion

This is the first paper to validate an instrument that measures the overuse of antibiotics at the patients/parents level. The study shows promising results, producing evidence of strong collection of conceptually homogenous items and clear alignment of the 'factors' with constructs identified in early phase. This instrument now needs further validation such as: confirming the construct validity using confirmatory factor analysis, and criterion-related validity.

Competing interest

There is no competing interest related to this study. Funding was received from University of Dammam, Saudi Arabia.

Authors' contributions

AA carried out the main intellectual contribution to the conception and design of the study, data collection, and made substantial contribution in the analysis and interpretation of the data. XH participated in the design of the study, and has been involved in revising the manuscript critically for important intellectual content. CH participated in the design of the study, made substantial contribution in the analysis and interpretation of the data, was involved in the revising the manuscript critically for important intellectual content, and has given the final approval of the version to be published. All authors read and approved the final manuscript.

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References

1. Jetacar: *The use of Antibiotics in Food-producing animals.* Australia: Commonwealth Department of Health and Aged Care; 1999.
2. Wutzke S, Artist M, Kehoe L, Fletcher M, Mackson J, Weekes L: **Evaluation of a national programme to reduce inappropriate use of antibiotics for upper respiratory tract infections: effects on consumer awareness, beliefs, attitudes and behaviour in Australia.** *Health Promot Int* 2007, **22:**53–64.
3. Cebotarenco N, Bush P: **Reducing antibiotics for colds and flu: a student-taught program.** *Heal Educ Res* 2008, **23:**146–157.
4. Huang S, Rifas-Shiman S, Kleinman K, Kotch J, Schiff N, Stille C, Steingard R, Finkelstein J: **Parental knowledge about antibiotic Use: results of a cluster-randomized, multicommunity intervention.** *Pediatrics* 2007, **119:**698–706.
5. Grigoryan L, Burgerhof J, Haaijer-Ruskamp F, Degener J, Deschepper R, Monnet D, Di Matteo A, Scicluna E, Bara A, Lundborg C, Birkin J: **Is self-medication with antibiotics in Europe driven by prescribed use?** *J Antimicrob Chemother* 2007, **59:**152–156.
6. Flora K, Scott W, Jason B, Jonathan Z: **Improving antibiotic utilization among hospitalists: A pilot academic detailing project with a public health approach.** *J Hosp Med* 2008, **3:**64–70.
7. Tenover F: **Mechanisms of antimicrobial resistance in bacteria.** *Am J Med* 2006, **119:**3–10.
8. Sorkhou I, Al-Qallaf B, Hajiah A, Al-Sheibani H, Bayoomi A, Mustafa A: **Perceptions of patients attending primary care in kuwait regarding upper respiratory tract infections.** *Kuwait medical Journal* 2002, **34:**272–275.
9. Green R: **Symptomatic treatment of upper respiratory tract symptoms in children.** *South African Family Practice* 2006, **48:**14–19.
10. Mora Y, Avila-Agtiero M, Umafia M, Jimenez A, Paris M, Faingezicht I: **Epidemiologic observations of the judicious use of antibiotics in a pediatric teaching hospital.** *Int J Infect Dis* 2002, **6:**74–77.
11. Irshaid Y, Al-Homrany M, Hamdi A, Adjepon-Yamoah K, Mahfouz A: **A pharmacoepidemiological study of prescription pattern in outpatient clinics in Southwestern Saudi Arabia.** *Saudi Med J* 2004, **25:**1864–1870.
12. Simasek M, Blandino D: **Treatment of the common cold.** *Am Fam Physician* 2007, **75:**515–520.
13. Awad A, Eltayeb I, Matowe L, Thalib L: **Self-medication with antibiotics and antimalarials in the community of khartoum state.** *Sudan J Pharm Pharmaceut Sci* 2005, **8:**326–331.
14. Chan G, Tang S: **Parental knowledge, attitudes and antibiotic use for acute upper respiratory tract infection in children attending a primary healthcare clinic in Malaysia.** *Singapore Med J* 2006, **47:**266–270.
15. Mitsi G, Jelastopulu E, Basiaris H, Skoutelis A, Gogos C: **Patterns of antibiotic use among adults and parents in the community: A questionnaire-based survey in a Greek urban population.** *Int J Antimicrob Agents* 2005, **25:**439–443.
16. Al-Azzam S, Al-Husein B, Alzoubi F, Masadeh M, Al-Horani M: **Self-medication with antibiotics in jordanian population.** *IJOMEH* 2007, **20:**373–380.
17. Sarahroodi S, Arzi A, Sawalha A, Ashtarinezhad A: **Antibiotics self-medication among southern iranian university students.** *Int J Pharmacol* 2010, **6:**48–52.
18. Crossley J, Eiser C, Davies H: **Children and their parents assessing the doctor–patient interaction: a rating system for doctors' communication skills.** *Medical Education* 2005, **39:**820–828.
19. Alumran A, Hou X-Y, Hurst C: *Assessing the overuse of antibiotics in children with URTIs in Saudi Arabia: Development of the parental perception on antibiotics scale (PAPA scale).* Journal of Epidemiology and Global Health; 2013.
20. Bawazir S: **Prescribing pattern at Community Pharmacies in Saudi Arabia.** *Int Pharm J* 1992, **6:**222–224.
21. Alumran A, Hurst C, Hou X-Y: **Antibiotics Overuse in Children with Upper Respiratory Tract Infections in Saudi Arabia: Risk Factors and Potential Interventions.** *Clinical Medicine and Diagnostics* 2011, **1:**8–16.
22. Kimberlin CL, Winterstein AG: **Validity and reliability of measurement instruments used in research.** *Am J Health Syst Pharm* 2008, **65:**2276–2284.
23. Ramaker C, Marinus J, Stiggelbout A, Van Hilten B: **Systematic evaluation of rating scales for impairment and disability in Parkinson's disease.** *Mov Disord* 2002, **17:**867–876.
24. Alumran A, Hou X-Y, Hurst C: **Validity and reliability of instruments designed to measure factors influencing the overuse of antibiotics.** *J Infect Public Health* 2012, **5:**221–232.
25. Colton D, Covert R: *Designing and constructing instruments for social research and evaluation.* San Francisco, CA: Jossey-Bass; 2007.
26. Corbett K, Gonzales R, Leeman-Castillo B, Flores E, Maselli J, Kafadar K: **Appropriate antibiotic use: variation in knowledge and awareness by Hispanic ethnicity and language.** *Prev Med* 2005, **40:**162–169.
27. Britten N, Ukoumunne O: **The influence of patients' hopes of receiving a prescription on doctors' perceptions and the decision to prescribe: a questionnaire survey.** *BMJ* 1997, **315:**1506–1510.
28. Akici A, Kalaca S, Ugurlu U, Oktay S: **Prescribing habits of general practitioners in the treatment of childhood respiratory-tract infections.** *Eur J Clin Pharmacol* 2004, **60:**211–216.
29. Larson E, Dilone J, Garcia M, Smolowitz J: **Factors which influence latino community members to self-prescribe antibiotics.** *Nurs Res* 2006, **55:**94–102.
30. Hasson F, Keeney S, McKenna H: **Research guidelines for the Delphi survey technique.** *J Adv Nurs* 2000, **32:**1008–1015.
31. Lawshe C: **A Quantitative approach to content validity.** *Pers Psychol* 1975, **28:**563–575.
32. Kogan M, Pappas G, Yu S, Kotelchuck M: **Over-the-counter medication Use among US preschool-age children.** *JAMA* 1994, **272:**1025–1030.

33. Bi P, Tong S, Partonc K: **Family self-medication and antibiotics abuse for children and juveniles in a Chinese city.** *Soc Sci Med* 2000, **50:**1445–1450.
34. Borg M, Scicluna E: **Over-the-counter acquisition of antibiotics in the Maltese general population.** *Int J Antimicrob Agents* 2002, **20:**253–257.
35. Svensson E, Haaijer-ruskamp F, Lundborg C: **Self-medication with antibiotics in a swedish general population.** *Scand J Infect Dis* 2004, **36:**450–452.
36. Linstone HA, Turoff M: *The Delphi method: techniques and applications.* Addison-Wesley Pub. Co.: Advanced Book Program; 1975.
37. Ray D, Rohren C: **Characteristics of patients with upper respiratory tract infection presenting to a walk-in clinic.** *Mayo Clin Proc* 2001, **76:**169–173.
38. Van Widenfelt BM, Treffers PDA, de Beurs E, Siebelink BM, Koudijs E: **Translation and Cross-Cultural Adaptation of Assessment Instruments Used in Psychological Research With Children and Families.** *Clinical Child and Family Psychology Review* 2005, **8:**135–147.
39. UNESCO IBoE: *World Data on Education.* 7th edition. Saudi Arabia:. 2010/11.

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Chapter 7: Instrument Development (Phase 3)

Title: Assessing the Psychometric Properties of the Parental Perceptions on Antibiotics (PAPA) Scales.

Citation: Alumran, A., Hou, X.-Y., Sun, J., Yousef, A. A., & Hurst, C. (2014). Assessing the construct validity and reliability of the parental perception on antibiotics (PAPA) scales. *BMC Public Health, 14*(73).

Date submitted: 23 January 2014

Contribution of authors:

AA and CH substantially participated in the conception and design of the study, and performed the statistical analysis and interpretation. AA and AY conducted data acquisition and AA drafted the manuscript. XH, JS, AY and CH helped to draft the manuscript and revising it critically for important intellectual content. All authors read and approved the final manuscript.

Summary of the results:

This study evaluates the psychometric properties of the Parental Perceptions on Antibiotics (PAPA) scales, which attempt to measure the factors influencing parental use of antibiotics in children. 1111 parents of children younger than 12 years old were recruited from primary schools' parental meetings in the Eastern Province of Saudi Arabia from September 2012 to January 2013. Confirmatory factor analysis was performed to validate the constructs of the instrument; model fit was evaluated using the raw and scaled $\chi 2$, Goodness of Fit Index, and Root Mean Square Error of Approximation. A five-factor model was confirmed with the model showing good fit. Constructs in the model include: Knowledge and Beliefs, Behaviors, Sources of information, Adherence, and Awareness about antibiotics resistance. The instrument was shown to have good internal consistency, and good discriminant and convergent validity.

This is the first study to attempt a comprehensive psychometric validation of an instrument that measures the psychosocial constructs underlying parental use of antibiotics in their children. Discovering the factors influencing antibiotic use will assist decision-making processes with regards to the best interventions and policy formulations targeted to reduce antibiotic overuse within the community. This, in turn, may reduce the burden of antibacterial resistance, in turn leading to a decrease in the burden of severe infectious diseases caused by antibacterial resistance strains.

Keywords:

Antibiotic overuse, Psychosocial, Measurement instrument, Reliability, Validity, Confirmatory factor analysis, Saudi Arabia.

Statement of Contribution of Co-Authors for Thesis by Published Paper

The following is the format for the required declaration provided at the start of any thesis chapter which includes a co-authored publication.

The authors listed below have certified* that:

1. they meet the criteria for authorship in that they have participated in the conception, execution, or interpretation, of at least that part of the publication in their field of expertise;
2. they take public responsibility for their part of the publication, except for the responsible author who accepts overall responsibility for the publication;
3. there are no other authors of the publication according to these criteria;
4. potential conflicts of interest have been disclosed to (a) granting bodies, (b) the editor or publisher of journals or other publications, and (c) the head of the responsible academic unit, and
5. they agree to the use of the publication in the student's thesis and its publication on the QUT ePrints database consistent with any limitations set by publisher requirements.

In the case of this chapter:

Publication title and date of publication or status: Assessing the Psychometric Properties of the Parental Perceptions on Antibiotics (PAPA) Scales.

Contributor	Statement of contribution*
Arwa Alumran  30/10/2013	Participated in the conception and design of the study and performed the statistical analysis and interpretation. Conducted data acquisition and drafted the manuscript
Xiang-Yu Hou	Helped to draft the manuscript and revising it critically for important intellectual content.
Jiandong Sun	Helped to draft the manuscript and revising it critically for important intellectual content.
Abdullah Yousef	Conducted data acquisition and helped to draft the manuscript and revising it critically for important intellectual content.
Cameron Hurst	Participated in the conception and design of the study and assisted in the statistical analysis and interpretation. Helped to draft the manuscript and revising it critically for important intellectual content.

Principal Supervisor Confirmation

I have sighted email or other correspondence from all Co-authors confirming their certifying authorship.

Xiang-Yu Hou		13/11/2013
Name	Signature	Date

Alumran et al. BMC Public Health 2014, 14:73
http://www.biomedcentral.com/1471-2458/14/73

BMC Public Health

RESEARCH ARTICLE Open Access

Assessing the construct validity and reliability of the parental perception on antibiotics (PAPA) scales

Arwa Alumran[1,2,3], Xiang-Yu Hou[1,2], Jiandong Sun[1,2], Abdullah A Yousef[4] and Cameron Hurst[5,6*]

Abstract

Background: The overuse of antibiotics is becoming an increasing concern. Antibiotic resistance, which increases both the burden of disease, and the cost of health services, is perhaps the most profound impact of antibiotics overuse. Attempts have been made to develop instruments to measure the psychosocial constructs underlying antibiotics use, however, none of these instruments have undergone thorough psychometric validation. This study evaluates the psychometric properties of the Parental Perceptions on Antibiotics (PAPA) scales. The PAPA scales attempt to measure the factors influencing parental use of antibiotics in children.

Methods: 1111 parents of children younger than 12 years old were recruited from primary schools' parental meetings in the Eastern Province of Saudi Arabia from September 2012 to January 2013. The structure of the PAPA instrument was validated using Confirmatory Factor Analysis (CFA) with measurement model fit evaluated using the raw and scaled χ^2, Goodness of Fit Index, and Root Mean Square Error of Approximation.

Results: A five-factor model was confirmed with the model showing good fit. Constructs in the model include: *Knowledge and Beliefs, Behaviors, Sources of information, Adherence,* and *Awareness about antibiotics resistance*. The instrument was shown to have good internal consistency, and good discriminant and convergent validity.

Conclusion: The availability of an instrument able to measure the psychosocial factors underlying antibiotics usage allows the risk factors underlying antibiotic use and overuse to now be investigated.

Keywords: Antibiotic overuse, Psychosocial, Measurement instrument, Reliability, Validity, Confirmatory factor analysis, Saudi Arabia

Background

Antibiotics are helpful in treating bacterial infections and are effective in reducing mortality and morbidity rates worldwide [1]. Since their introduction, antibiotic usage has become very widespread. The increased usage of antibiotics increases the potential for antibiotic overuse and misuse [2-9], including in children [10]. This growing global public health issue needs to be addressed and managed.

The overuse of antibiotics may cause several harmful effects at both the individual, and the community, level. One of the most important individual risk factors is the development of preventable adverse effects (e.g. adverse gastrointestinal effects) [5,11]. These adverse effects represent a more significant issue in children [8]. Community level risk factors are potentially more serious, and include the development of antibacterial resistance and raising the burden of chronic diseases, which leads to an increase in unnecessary expenditure on health services [12-15].

Antibacterial resistance is a growing public health issue worldwide, and represents a risk to both the community and the individual [6-8]. Antibiotic resistance is highly associated with the overuse of antibiotics to treat viral URTIs [1]. With the emergence of antibacterial resistance, it is inadvisable to use antibiotics indiscriminately [16]. Promoting judicious use of antibiotics by

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parents could protect children from antibacterial resistance, especially in countries where antibiotics can be obtained without prescription.

In many countries, the problem of antibiotic overuse is exacerbated as a result of policy shortfalls, or inadequate regulation on the distribution of antibiotics. In many of these countries, antibiotics can be purchased over-the-counter at pharmacies without a prescription from a doctor. This takes the decision of antibiotic use out of the hands of the medical professional, and places the decision to use antibiotics firmly with consumers and parents.

Antibiotics are often inappropriately used to treat viral infections including most upper respiratory tract infections (URTIs). URTIs are the most common infections around the world [1,15-18]. Most infections of the upper respiratory tract are viral in nature and neither require, or are effectively treated by, antibiotics [19]. The use of antibiotics to treat viral URTIs is considered a misuse of antibiotics [4,20-23]. Parents' knowledge regarding URTIs and their treatment needs to be assessed in order to develop strategies that may reduce antibiotic overuse in children.

Several factors might cause a community to overuse antibiotics. These include: (1) factors related to policy controls and regulations governing availability of antibiotics; (2) factors related to public consumption such as attitudes, beliefs, knowledge of antibiotic use, and behaviors (e.g. over-the-counter medication and self-medication); (3) patients' perceptions regarding patient-doctor interaction; and (4) patient satisfaction of experiences with antibiotics [24-30]. In order to measure the factors associated with the public's patterns of antibiotic use, a valid and reliable instrument able to tease out the psychosocial constructs representing consumers' attitudes, beliefs and behaviors to antibiotics needs to be available. An extensive literature review concluded that, at this time, there is no validated instrument that measures the factors influencing parents' use of antibiotics in children, in particular, or for patients, in general [31].

The parental perceptions on antibiotics (PAPA) instrument was developed [32] and has undergone preliminary validation [33] to assess the factors influencing parents' use of antibiotics in children (especially with URTIs). Both survey items, and the domains in which they were grouped, were developed using a literature review [31,34] and content-validated by an extensive Delphi process using experts' knowledge about the use of antibiotics [32]. The developed instrument (PAPA scales) needs to undergo further analysis of its psychometric properties to be considered fully valid and reliable for use in future research.

Construct validation

Construct validity is the extent to which an instrument measures the construct that it is intended to measure. According to Ramaker *et al.* (2002) [35], factor analysis is often used to measure the inter-correlation of the instrument's components, which subsequently assists in condensing the number of dimensions in the instrument by grouping the related items under the same dimension. Construct validity is achieved when the tool: (1) measures the differences between contrasting groups of participants, (2) reflects the framework hypothesized in a hypothesis testing study, and (3) can undergo a confirmatory factor analysis which adequately establishes that the measurement model fits the actual data [36]. The aim of this study is to investigate the psychometric properties of the PAPA scales and to demonstrate preliminary evidence of construct validity of the PAPA instrument.

Methods

Participants

Like many analyses containing a large number of variables, CFA is generally too complex to prospectively power. Typically, little is known about minimal clinical differences and standard deviations associated with both observed and latent variables. Instead, 'rules of thumb' are used to guide in the selection of sample size. We used the sample size approach advocated by Comrey and Lee [37]: 100 = fair, 200 = good, 500 = very good, and >1000 = excellent. We were conservative in the selection of sample size in case subgroup analyses were required (e.g. mother and fathers). Given the informal nature of the Comery and Lee [37] approach, it is important to note the effect sizes (i.e. magnitude of loadings and inter-factor correlations) to gauge the contextual importance of parameter estimates in any subsequent analysis.

Participants comprised a sample of parents attending parental meetings in primary schools in the Eastern Province of Saudi Arabia. Of the 1395 people sampled, 1111 (79.6%) completed and returned their survey. Just over half of the participants were mothers (52%); the majority were not trained in health fields (88.8%); more than half of the sample were employed (57.2%); and only 1% were illiterate, with most of the sample having a diploma or a bachelors degree (62.2%). Parents were aged between 19 and 72 years (median = 37; mean = 38.11, SD = 7.7). Geographical background was reported with 44% of the participants stating they were originally from the Eastern Province, while the rest of the participants' origins were equally distributed among the other provinces, with the exception of the Northern Province, which was represented by only 3.6% of the individuals.

Measures

The PAPA instrument [33] is a 32-item instrument that aims to measure the psychosocial factors influencing the overuse of antibiotics in children, especially with upper

respiratory tract infections. Items in the instrument are available in Additional file 1. Depending on the nature of the item, parents were asked to rate on a 5-point Likert scale ranging from *strongly disagree* to *strongly agree* or from *never* to *always.* The development, translation, and preliminary validation of the PAPA scales are reported elsewhere [32,33].

The questionnaire measures the following criteria: (1) parents' demographic characteristics such as gender, number of girls and boys in the family, health training, age, employment status and education levels, geographical background, when they moved to the Eastern Province, and monthly income; (2) child health-related history including the number of cold episodes and antibiotics (courses) used for the youngest child during the last year (ranging from never to more than 6 times a year), and whether any of the children in the family has ever had a serious infectious disease or a chronic disease; and (3) items relating to parents' psychosocial factors influencing the parental use of antibiotics including knowledge and beliefs, behaviors, adherence, seeking information, awareness about antibiotics resistance, and parents' perception about doctors' prescribing behavior.

Knowledge and beliefs

The knowledge and beliefs scale includes 10 items that measure the extent of parents' knowledge and beliefs with regards to antibiotics use. Knowledge and beliefs items include questions such as: measuring the parents' perceptions regarding *the necessity to use an antibiotic for: the common cold* [KB1], *and/or a sore throat* [KB2]. This construct shows good internal consistency in this sample (Cronbach's α = 0.836).

Behaviors

This 5-item scale assesses the behaviors of parents with regards to the use of antibiotics. Most of the behavior-related questions are about past experiences such as: *In the past, I have stopped giving my child an antibiotic because my friends/family advised me to* [B5]. This construct shows good internal consistency in this sample (Cronbach's α = 0.771).

Seeking information

This 7-item construct assesses the sources parents use to get their health-related information such as: *nurses and/or other allied health professionals* [SI1]. The Seeking information scale shows good internal consistency in this sample (Cronbach's α = 0.834).

Adherence

This 5-items subscale assesses the level of parents' adherence to specific doses of antibiotics in their children. It is represented by questions such as: *skipping one or two antibiotic doses doesn't make much difference* [AD1]. This construct shows good internal consistency in this sample (Cronbach's α = 0.765).

Awareness about antibiotics resistance

This is a 5-item factor that assesses the parents' awareness about antibiotic resistance. It includes items such as: *antibiotics can be harmful to one's health* [ABR1]. The internal consistency in this sample for this construct appears to be moderate (Cronbach's α = 0.462).

The *Parents' perception regarding doctors' prescribing behaviors*' (PPD) was also initially included in the instrument. This factor was included to measure how parents perceived the prescribing behavior of the doctor (e.g. Insufficiently forthcoming with a prescription for antibiotics). The PPD factor had adequately high loadings in the EFA analysis to warrant it's consideration in the CFA [33]. However, in our initial CFA (the six factor instrument), the PPD items loaded somewhat lower than in the EFA, although they were still statistically significant ($p < 0.001$). The main difficulty presented in the initial six-factor measurement model was that PPD factor was not associated with any of other factor in the measurement model. This implies the original six-factor instrument may be too broad in it's specification, and this is reflected by the lack of fit of the six-factor model (raw $\chi^2 = 3442.63$, df = 579, $p < 0.001$; $\chi^2/df = 5.946$; GFI = 0.839; RSMEA = 0.067). Exclusion of the PPD items from the PAPA instrument substantially improved the model fit (see details in results section) so it was decided that a five-factor model (excluding PPD) might represent a more appropriately scoped model to measure parental perceptions about antibiotics.

Procedure

This study was cross-sectional and employs a previously developed [32], and preliminary validated instrument [33]. Ethical clearances were obtained from Queensland University of Technology in Australia (Ethical approval number: 1200000022) and the Department of Development and Planning in the Ministry of Education in the Eastern Province in Saudi Arabia (Ethical approval number: 33505889). The Arabic questionnaire was distributed to parents of children younger than 12 years old in primary schools in the Eastern Province of Saudi Arabia in September 2012 to January 2013. Attending these meetings is considered a social obligation in Saudi Arabia, thus making the sample a representative one of the Saudi population, adding to the likelihood of external validity of the results. Participants' consent was implied in the return of the completed questionnaire as shown in the questionnaire's cover page.

Instrument development

The PAPA instrument was developed [32] using a content evaluation panel of expert from Australia and Saudi

Arabia; the panel of experts were used to conduct the brainstorming process [38]. The instrument's items were derived from relevant literature, followed by a three-round Delphi Process using content experts. Experts included in preliminary development step came from areas such as: paediatrics, infectious diseases, epidemiology, family medicine, psychology and counselling, and social sciences.

A *priori* model

After the development of the instrument [32], parallel analysis and Exploratory Factor Analysis (EFA) using principal axis factoring were conducted to determine the number and nature of the underlying factors in the instrument [33]. Six factors were produced from the analysis: knowledge and beliefs, behaviors, sources of information, adherence, awareness about antibiotics resistance, and parents' perception regarding doctors' prescribing behaviors. Also, the instrument's reliability was established with Cronbach's alpha = 0.78. The constructs produced in the priori model coincide with the constructs contextually available in the relevant literature [33].

An Oblique (Promax) model was chosen after comparing principal axis factoring models with orthogonal (Varimax) and oblique rotations. The latter of these two models was clearly more realistic and revealed substantial correlations among many of the factors [33].

Statistical analysis

After conducting the EFA analysis using Statistics Package for Social Sciences (SPSS v19: [39]), the resulting constructs from the EFA using Principal Axis Factoring [33] were validated using Confirmatory Factor Analysis (CFA) in AMOS and Stata/SE v12. Results suggested that only five out of the six initial factors should be included in the final CFA model (see above). This study assesses the CFA using a different dataset from the one used in EFA (sample size $n = 1111$).

We initially tried fitting our CFA model using Maximum Likelihood Estimation, but noticed that Generalized Least Squares provided a superior fit. The model fit was evaluated using the Goodness of Fit Index (GFI; [40]), Root Mean Square Error of Approximations (RMSEA; [41]), and the raw and modified χ^2 fit statistics. It is important to note that the raw and modified χ^2 are usually upwardly biased with sample size [42,43] and are included here only for convention. GFI evaluates the model fit by measuring the fit between an estimated model and the observed covariance matrix [40]. A GFI greater than 0.9 is considered a good fit [44]. The RMSEA evaluates the model fit by assessing how well an unknown but optimally chosen parameter estimates fit the population covariance matrix [42] and an RMSEA value of less than 0.06 suggests a good model fit [41].

To establish there was no bias in the pattern of missing values, missing values were analysed using Little's MCAR test [45] to determine if the missing values are missing completely at random. Only 1.3% of the data was missing, and Little's MCAR test [45] showed missing values were missing completely at random (p-value = 0.446). The frequency of missing values ranged from 0.4 to 3.3%. Expectation Maximization Technique [40] was used to impute missing values for the purpose of CFA, with all discrete variable imputations rounded to the nearest integer. The internal consistency of the PAPA scales was assessed using Cronbach's alpha.

To evaluate Convergent validity, the Average Variance Extracted (AVE) for each construct was evaluated against its correlation with the other constructs. Where AVE was larger than the construct's correlation with other constructs, then Convergent validity was considered to be confirmed [46]. Discriminant validity was established where Maximum Shared Variance (MSV) and the Average Shared Squared Variance (ASV) were both lower than the Average Variance Extracted (AVE) for all the constructs [47].

The total score for each subscale was computed using the loadings for each item produced from the CFA. Each subscale was defined according to what it measures: (1) Knowledge and Beliefs [KB] measures the parents' knowledge and beliefs about the appropriate use of antibiotics; (2) Behaviours [B] measures the parents' appropriate behaviours regarding the use of antibiotics; (3) Seeking Information [SI] measures the extent to which parents are proactive in educating themselves about antibiotics from various sources; (4) Antibiotic Adherence [AD] measures the parents' adherence to appropriate antibiotic doses; and (5) Awareness about antibiotic resistance [ABR] measures the parents' awareness about antibiotic resistance.

A higher score in the 'Knowledge and Beliefs' scale means better knowledge regarding antibiotic use; a higher score in the 'Behaviors' scale means better judicious behavior regarding antibiotics use; a higher score in the 'Adherence' scale means better adherence to appropriate antibiotic doses; a higher score in the 'Seeking Information' scale means more eagerness to seek health-related information; and finally a higher score in the 'Awareness about Antibiotics Resistance' scale means better awareness regarding antibiotics resistance. All items worded negatively were reverse coded for the purpose of analysis.

Results

The measurement model fit using CFA is shown in Figure 1. The model fit the data adequately with a good GFI (GFI = 0.915) and RMSEA (RMSEA = 0.047). The raw χ^2 is 1470.334 and χ^2/df is 3.484 with p-value < 0.0001.

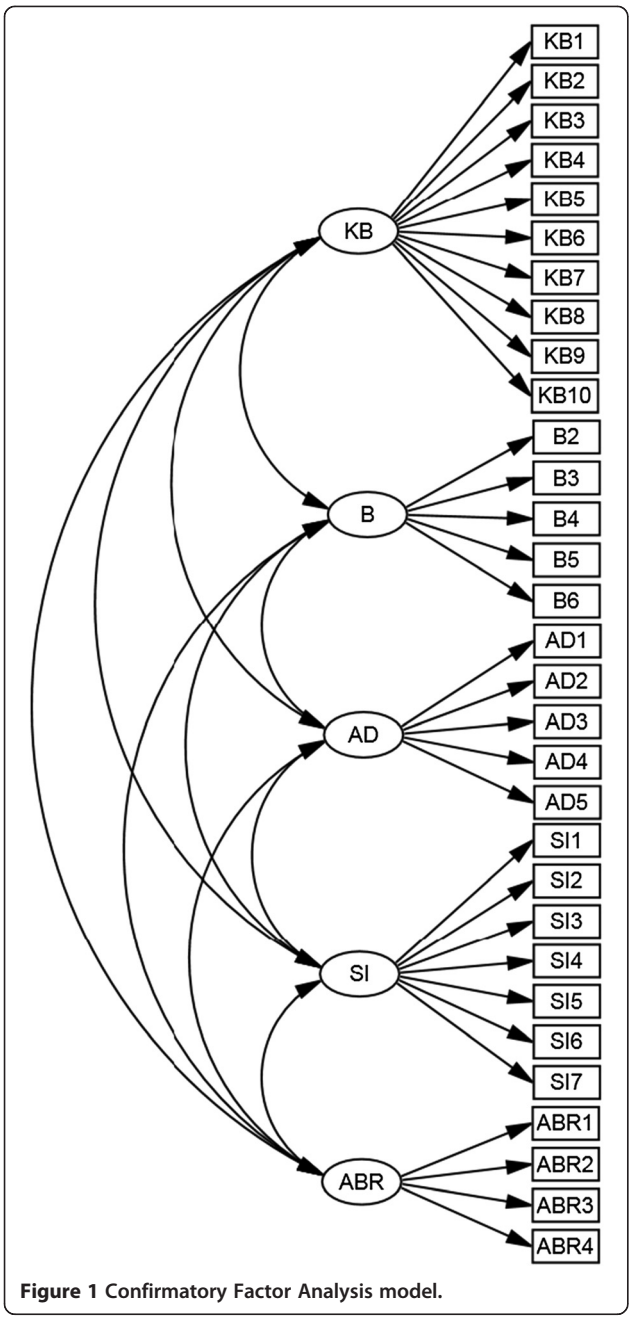

Figure 1 Confirmatory Factor Analysis model.

However, the raw and scaled χ^2 are highly influenced by the sample size [42]. To test this hypothesis, we performed a post hoc analysis by randomly selecting 50% of the sample and rerunning the model; the new raw and scaled χ^2 are 875.123 and 2.074 respectively. Counter-intuitively, the χ^2 reduced dramatically with the reduction of sample size; this concurs with reports from other studies [43].

The means and standard deviations of the individual items in the instrument are presented in Table 1, where 1 is for 'Strongly disagree' or 'never' and 5 is for 'strongly agree' or 'always' depending on the nature of the question.

Table 1 EFA and CFA Loadings

Items	Loadings		Mean (SD)	Items	Loadings		Mean (SD)
	β	*u*			β	*u*	
KB1	-0.646	-0.627	2.8 (1.2)	B1	[a]	-0.443	1.6 (1.0)
KB2	-0.367	-0.631	3.2 (1.2)	B2	-0.617	-0.809	1.7 (1.0)
KB3	-0.292	-0.461	3.3 (1.2)	B3	-0.609	-0.534	1.8 (1.1)
KB4	-0.264	-0.574	3.1 (1.1)	B4	-0.825	-0.874	1.8 (1.1)
KB5	-0.660	-0.687	3.2 (1.1)	B5	-0.318	-0.426	1.6 (1.0)
KB6	-0.679	-0.613	2.9 (1.2)	B6	-0.375	-0.623	1.6 (1.0)
KB7	-0.719	-0.672	2.6 (1.2)	AD1	-0.415	-0.716	1.9 (1.0)
KB8	-0.669	-0.749	3.3 (1.1)	AD2	-0.772	-0.902	2.5 (1.3)
KB9	-0.591	-0.628	3.5 (1.0)	AD3	-0.697	-0.517	2.3 (1.2)
KB10	-0.405	-0.594	3.6 (1.0)	AD4	-0.508	-0.697	2.6 (1.3)
SI1	0.427	0.472	2.7 (1.2)	AD5	-0.306	-0.465	1.7 (0.9)
SI2	0.812	0.759	2.8 (1.2)	ABR1	0.468	0.444	3.8 (1.1)
SI3	0.660	0.621	2.3 (1.0)	ABR2	0.572	0.446	3.3 (1.0)
SI4	0.824	0.773	2.6 (1.1)	ABR3	0.587	0.674	3.8 (1.0)
SI5	0.830	0.789	2.6 (1.1)	ABR4	0.186	0.446	3.7 (1.0)
SI6	0.657	0.556	3.3 (1.1)	ABR5	[b]	0.422[c]	
SI7	0.281	0.479	2.6 (1.2)				

Standardized betas (β) from the Confirmatory Factor Analysis and loadings (*u*) from the Exploratory Factors Analysis for the items in the instrument.
All βs in the model are significant at the 0.001 level.
[a]The item was significantly correlated with its factor but had to be removed because it did not load contextually on the construct.
[b]Item was removed from the CFA model because it was not significant.
[c]Items associated with negative loadings in the EFA were reversed scored to get the positive loadings in CFA.
Abbreviations: *KB* Knowledge and beliefs, *B* Behaviors, *SI* Seeking Information, *AD* Adherence, *ABR* Awareness about Antibiotics Resistance.

All items in the model loaded significantly at the 0.001 level of significance on their respective factors with standardized betas ranging from 0.19 to 0.83 as shown in Table 1. Out of the ten possible inter-factor correlations, four were significant (Table 2). Furthermore, no substantial cross-loadings (beta > 0.35) were observed in either the EFA [33], nor the CFA.

The construct 'Awareness about antibiotics resistance' showed only moderate to low internal consistency due to the inclusion of the item that asks about the use of antibiotics to treat bacterial infections. This item exhibited quite

Table 2 Inter-factor correlations

	Knowledge and beliefs	Seeking information	Adherence	Behaviors
Seeking information	0.079			
Adherence	0.329*	0.086		
Behaviors	0.212*	0.143	0.332*	
Awareness about antibiotics resistance	-0.154	0.196*	-0.138	0.015

*Significant correlation (p<0.05).

a low loading on its respective factor (β = 0.19) but it was included in the model since the item was considered to measure a very important aspect in the ABR scale and this item was shown to have statistically significant association with its factor (β_{ABR4}: 0.186, $p < 0.001$).

The AVE of the constructs in the study were measured and compared to the inter-factor correlations [46]. Preliminary evidence of convergent validity was determined when the AVE of each construct was higher than its correlation with other constructs. While discriminant validity of the PAPA scale was preliminarily determined by assessing the Maximum Shared Variance (MSV) and the Average Shared Squared Variance (ASV), both were found to be lower than the Average Variance Extracted (AVE) for all of the constructs in the scale [47]. Convergent and Discriminant validities results are available in Table 3.

Common Method Bias was evaluated using Harman's single factor test [48], which determines if the majority of the variance can be explained by a single factor. Common method bias occurs if there is a systematic source of measurement error [49]. In our model, the variance of a single factor was 18.36% indicating there is no common method bias.

Discussion

The aim of this study was to validate the Parental Perceptions of Antibiotics scales. After producing 36 items from the EFA, CFA was conducted to test the validity of these items. Only 31 items were included in a 5-factor model for the CFA. The five remaining items did not fit the factor structure because: (1) a 3-item factor suggested by the EFA, Parents' perception about doctors prescribing behavior, led to a poor specification for the initial CFA model; (2) one of the items from the 'Awareness about antibiotics resistance' construct was removed because it did not load significantly on its respective factor; and (3) one of the items in the 'behaviors' construct was removed since it measured attitudes rather than behavior, and also, another item in the same factor measured a similar aspect, but this latter item was worded to reflect behavior rather than attitude. The resulting 5-factor structure was confirmed as adequately fitting the data. The five factors were: *Knowledge and Beliefs*, *Behaviors*, *Seeking Information*, *Antibiotic adherence*, and *Awareness about antibiotic resistance*.

Table 3 Convergent and Discriminant validities assessment

Scales	AVE	MSV	ASV
Knowledge and beliefs	0.308	0.108	0.046
Behaviors	0.335	0.110	0.044
Sources of Information	0.451	0.038	0.018
Antibiotics Adherence	0.321	0.110	0.061
Awareness about antibiotics resistance	0.231	0.038	0.020

AVE Average Variance Extracted.
MSV Maximum Shared Variance.
ASV Average Shared Squared Variance.

Our initial inclusion of a subscale to measure parental perceptions regarding doctors prescribing behaviour was revealed to have no place in the PAPA instrument. We still believe this is an important aspect to parental use/misuse of antibiotic in their children, but it may need to be measured separately.

The internal consistency of the individual factors is high except for one factor that demonstrated moderate-low internal consistency. The moderate-low internal consistency of the factor 'Awareness about antibiotics resistance' is due to the inclusion of an item with a low, but significant, loading. The item was included because it measures an important aspect.

When parents were asked about the use of antibiotics for common cold, 36% stated that the use of antibiotic was appropriate, while 47% agreed in other studies [50]. Almost half of the sample believed that antibiotics cure children with common cold faster; this coincides with other studies [51,52]. In the study, 43% of the parents believed that antibiotics cure all types of infections including viral, fungal, and bacterial; this concurs with other studies with similar results [53]. In addition, 69% of parents agreed that antibiotics cure bacterial infections. When this aspect was measured in other studies, it produces similar results [52]. These measures of knowledge and beliefs coincide with other studies.

Most parents in the study show good-to-moderate awareness about antibiotic resistance; similar results have been documented in other studies [50,53]. More than half of the parents in our study (56%) indicated that they expect medication (including an antibiotic) when they visit the doctor for their child's common cold. This result contrasts to the findings in other studies where only about 10% of the parents expected medication (including antibiotics) to treat the common cold [51,52]. This difference in the expectation of antibiotics between the Saudi population and those considered in other studies might be related to the parents' knowledge or other parental psychosocial factors. Consequently, conducting studies similar to this one will inform researchers on the public's current knowledge and other psychosocial factors related to the parental use of antibiotics in children and thus target these risk factors.

Approximately 33% of the parents in the study get their health-related information from books and scientific literature, 16% from family and/or friends, and 28% from the Internet. Larson et al. (2006) [53] measured the patient's sources of information as well, and found that 44% get their health- related information from books and scientific literature, 36% from family and friends,

and only 8% from the Internet. The difference in the frequency of getting health- related information from the Internet between our study and Larson et al. (2006) [53] is probably due to temporal variability; where in more recent times, is more accessible, and the usage of the internet to obtain information is now more culturally ingrained.

Some correlations were found within the psychosocial factors in the present study. For instance, parents' knowledge and beliefs scale was correlated with antibiotics adherence, which is similar to results from other studies [54]. However, the absence of validated instruments for measuring constructs underlying antibiotic use means there is little empirical evidence regarding theory, making present theory in this area, somewhat speculative. In addition, some of the correlations identified in the present study seem contextually sensible. For instance, the positive association between antibiotic adherence and behavior, or the more proactive a parent is seeking of health-related information, the higher their awareness about antibiotic resistance.

The questionnaire used in this study also measures the following criteria: (1) parents' demographics characteristics such as: gender, number of girls and boys in the family, health training, age, employment status and education levels, geographical background, when they moved to the Eastern Province, and monthly income; and (2) child health-related history including the number of cold episodes and antibiotics used for the youngest child during the last year (ranging from never to more than 6 times a year), and whether any of the children in the family has ever had a serious infectious disease or a chronic disease.

A validated instrument that measures the psychosocial constructs underpinning antibiotic use will allow the investigation of two important sets of relationships. First, what are the parental characteristics associated with the knowledge and behavior relating to antibiotic use (and misuse) in children? Second, how do the various PAPA scales relate to parental practice in terms of administering antibiotics to their children? Further studies are needed to evaluate the PAPA scales (i.e. Knowledge and beliefs, Behaviors, Adherence, Seeking information, and Awareness about antibiotic resistance) against antibiotic consumption.

Limitations

Since this is the first instrument of its kind to have been fully validated, there are no gold standards to evaluate criteria against it. Criterion related validity cannot be established for this instrument. Also, at this stage of the instrument's development, we have little idea of its generalizability to other populations. Further studies of the psychometric properties of the PAPA scales in other populations is needed to fully construct validate this instrument.

Conclusion

This is the first study to attempt a comprehensive psychometric validation of an instrument that measures the psychosocial constructs underlying parental use of antibiotics in their children. An instrument with a 5-factor structure, the PAPA scales, shows strong potential for construct validity. The effectiveness of the PAPA instrument in other populations needs to be established, thereby allowing the investigation of risk factors of antibiotic overuse in populations across the world. Discovering the factors influencing antibiotic use will assist decision-making processes with regards to the best interventions and policy formulations targeted to reduce antibiotic overuse within the community. This, in turn, may reduce the burden of antibacterial resistance, in turn leading to a decrease in the burden of severe infectious diseases caused by antibacterial resistance strains.

Additional file

Additonal file 1: Items in the PAPA scales.

Abbreviations

PAPA: Parents perceptions on antibiotics; URTI: Upper respiratory tract infection; KB: Knowledge and beliefs; B: Behaviors; AD: Adherence; SI: Seeking information; ABR: Awareness about antibiotic resistance; CFA: Confirmatory factor analysis; EFA: Exploratory factor analysis; GFI: Goodness of fit index; RMSEA: Root mean square error of approximations; AVE: Average variance extracted; MSV: Maximum shared variance; ASV: Average shared squared variance.

Competing interests

The article processing fees are paid by Queensland University of Technology, Australia. There are no other competing interests relating to this research.

Authors' contributions

AA and CH substantially participated in the conception and design of the study, and performed the statistical analysis and interpretation. AA and AY conducted data acquisition and AA drafted the manuscript. XH, JS, AY and CH helped to draft the manuscript and revising it critically for important intellectual content. All authors read and approved the final manuscript.

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References

1. Teng C, Leong K, Aljunid S, Cheah M: **Antibiotic prescription in upper respiratory tract infections.** *Asia Pac Fam Med* 2004, **3:**38–45.
2. Cebotarenco N, Bush P: **Reducing antibiotics for colds and flu: a student-taught program.** *Health Educ Res* 2008, **23:**146–157.
3. Ahmed K, Al-Saadi A: **A survey of multiple prescriptions dispensed in Saudi Arabia.** *Pak J Pharm Sci* 2005, **18:**1–2.
4. Al-Faris E, Al-Taweel A: **Audit of prescribing patterns in Saudi primary health care: What lessons can be learned?** *Ann Saudi Med* 1999, **19:**317–321.
5. Irshaid Y, Al-Homrany M, Hamdi A, Adjepon-Yamoah K, Mahfouz A: **A pharmacoepidemiological study of prescription pattern in outpatient clinics in Southwestern Saudi Arabia.** *Saudi Med J* 2004, **25:**1864–1870.
6. JETACAR: *The use of Antibiotics in Food-Producing Animals.* Australia: Commonwealth Department of Health and Aged Care; 1999.
7. Mainous A, Hueston W, Davis M, Pearson W: **Trends in antimicrobial prescribing for bronchitis and upper respiratory infections among adults and children.** *Am J Public Health* 2003, **93:**1910–1914.
8. Simasek M, Blandino D: **Treatment of the common cold.** *Am Fam Physician* 2007, **75:**515–520.
9. Simoes E, Cherian T, Chow J, Shahid-Salles S, Laxminarayan R, John T: *Disease Control Priorities in Developing Countries.* 2nd edition. World Bank: Washington (DC); 2006.
10. Huang S, Rifas-Shiman S, Kleinman K, Kotch J, Schiff N, Stille C, Steingard R, Finkelstein J: **Parental knowledge about antibiotic use: results of a cluster-randomized, multicommunity intervention.** *Pediatrics* 2007, **119:**698–706.
11. Al-Hassan MI: **Community pharmacy practice in Saudi Arabia: an overview.** *The Internet Journal of Pharmacology* 2011, **9**. Available from: http://ispub.com/IJPHARM/9/1/5301 [Last accessed on 2014 Jan 16].
12. Sorkhou I, Al-Qallaf B, Hajiah A, Al-Sheibani H, Bayoomi A, Mustafa A: **Perceptions of patients attending primary care in Kuwait regarding upper respiratory tract infections.** *Kuwait med J* 2002, **34:**272–275.
13. Mora Y, Avila-Agtiero M, Umafia M, Jimenez A, Paris M, Faingezicht I: **Epidemiologic observations of the judicious use of antibiotics in a pediatric teaching hospital.** *International Journal of Infectious Diseases* 2002, **6:**74–77.
14. Emanuele P: *Antibiotic resistance. AAOHN Journal* 2010, **58:**363–365.
15. West J: **Acute upper airway infections: childhood respiratory infections.** *Br Med Bull* 2002, **61:**215–230.
16. Green R: **Symptomatic treatment of upper respiratory tract symptoms in children.** *SA Fam Pract* 2006, **48:**14–19.
17. Palmer D, Bauchner H: **Parents' and physicians' views on antibiotics.** *Pediatrics* 1997, **99:**6–10.
18. Bhasin S, Budden E, Ketkar A, Pawar A: **Current trends in the treatment of upper respiratory tract infections in neonates, infants and children: a survey.** *Indian J Pharmacol* 2002, **34:**62–63.
19. Wutzke S, Artist M, Kehoe L, Fletcher M, Mackson J, Weekes L: **Evaluation of a national programme to reduce inappropriate use of antibiotics for upper respiratory tract infections: effects on consumer awareness, beliefs, attitudes and behaviour in Australia.** *Health Promotion International* 2007, **22:**53–64.
20. Arroll B, Kenealy T: **Antibiotics for the common cold and acute purulent rhinitis (Review).** *Cochrane Database of Systematic Reviews* 2005, **3:**CD000247.
21. Fahey T, Stocks N, Thomas T: **Systematic review of the treatment of upper respiratory tract infection.** *Arch Dis Child* 1998, **79:**225–230.
22. Hoa NQ, Larson M, Chuc NTK, Eriksson B, Trung NV, Stalsby CL: **Antibiotics and paediatric acute respiratory infections in rural Vietnam: health-care providers, knowledge, practical competence and reported practice.** *Tropical Medicine & International Health* 2009, **14:**546–555.
23. Skull S, Ford-Jones E, Kulin N, Einarson T, Wang E: **Child care center staff contribute to physician visits and pressure for antibiotic prescription.** *Arch Pediatr Adolesc Med* 2000, **154:**180–183.
24. Awad A, Eltayeb I, Matowe L, Thalib L: **Self-medication with antibiotics and antimalarials in the community of Khartoum State, Sudan.** *J Pharm Pharmaceut Sci* 2005, **8:**326–331.
25. Chan G, Tang S: **Parental knowledge, attitudes and antibiotic use for acute upper respiratory tract infection in children attending a primary healthcare clinic in Malaysia.** *Singapore Med J* 2006, **47:**266–270.
26. Mitsi G, Jelastopulu E, Basiaris H, Skoutelis A, Gogos C: **Patterns of antibiotic use among adults and parents in the community: a questionnaire-based survey in a Greek urban population.** *Int J Antimicrob Agents* 2005, **25:**439–443.
27. Al-Azzam S, Al-Husein B, Alzoubi F, Masadeh M, Al-Horani M: **Self-medication with antibiotics in Jordanian population.** *IJOMEH* 2007, **20:**373–380.
28. Grigoryan L, Burgerhof J, Haaijer-Ruskamp F, Degener J, Deschepper R, Monnet D, Di Matteo A, Scicluna E, Bara A, Lundborg C, Birkin J: **Is self-medication with antibiotics in Europe driven by prescribed use?** *J Antimicrob Chemother* 2007, **59:**152–156.
29. Sarahroodi S, Arzi A, Sawalha A, Ashtarinezhad A: **Antibiotics self-medication among southern Iranian university students.** *International Journal of Pharmacology* 2010, **6:**48–52.
30. Crossley J, Eiser C, Davies H: **Children and their parents assessing the doctor–patient interaction: a rating system for doctors' communication skills.** *Medical Education* 2005, **39:**820–828.
31. Alumran A, Hou X-Y, Hurst C: **Validity and reliability of instruments designed to measure factors influencing the overuse of antibiotics.** *J Infect Public Health* 2012, **5:**221–232.
32. Alumran A, Hou X-Y, Hurst C: **Assessing the overuse of antibiotics in children with URTIs in Saudi Arabia: development of the parental perception on antibiotics scale (PAPA scale).** *J Epidemiol Glob Health* 2013, **3:**3–10.
33. Alumran A, Hou X-Y, Hurst C: **Assessing the overuse of antibiotics in children in Saudi Arabia: validation of the parental perception on antibiotics scale (PAPA scale).** *Health Qual Life Outcomes* 2013, **11:**39.
34. Alumran A, Hurst C, Hou X-Y: **Antibiotics overuse in children with upper respiratory tract infections in Saudi Arabia: risk factors and potential interventions.** *Clinical Medicine and Diagnostics* 2011, **1:**8–16.
35. Ramaker C, Marinus J, Stiggelbout A, Van Hilten B: **Systematic evaluation of rating scales for impairment and disability in Parkinson's disease.** *Movement Disorders* 2002, **17:**867–876.
36. DeVon H, Block M, Moyle-Wright P, Ernst D, Hayden S, Lazzara D, Savoy S, Kostas-Polston E: **A Psychometric toolbox for testing validity and reliability.** *Journal of Nursing Scholarship* 2007, **39:**155–164.
37. Comrey AL, Lee HB: *A First Course in Factor Analysis.* Hillsdale, NJ: Erlbaum; 1992.
38. Colton D, Covert R: *Designing and Constructing Instruments for Social Research and Evaluation.* San Francisco, CA: Jossey-Bass; 2007.
39. IBM C: *IBM SPSS Statistics for Windows.* 190th edition. IBM Corp: Armonk, NY; 2010.
40. Tabachnick B, Fidell L: *Using Multivariate Statistics.* New York: Allyn and Bacon; 2013.
41. Browne MW, Cudeck R: *Alternative Ways of Assessing Model fit.* Beverly Hills, CA: Sage; 1993.
42. Hooper D, Coughlan J, Mullen M: **Structural equation modelling: guidelines for determining model fit.** *The Electronic Journal of Business Research Methods* 2008, **6:**53–60.
43. Stallman HM, Hurst CP: **The factor structure of the frost multidimensional perfectionism scale in university students.** *Australian Psychologist* 2011, **46:**229–236.
44. Byrne BM: *Structural Equation Modeling with EQS and EQS/Windows.* Thousand Oaks, CA: Sage Publications; 1994.
45. Little R: **A test of missing completely at random for multivariate data with missing values.** *Journal of American Statistical Association* 1988, **83:**1198–1202.
46. Gefen D, Straub D, Boudreau M-C: **Structural equation modeling and regression: guidelines for research practice.** *Communications of the AIS* 2000, **4:**1–78.
47. Hair J, Black W, Babin B, Anderson R: *Multivariate Data Analysis.* 7th edition. Upper Saddle River, NJ, USA: Prentice-Hall, Inc.; 2010.
48. Harman H: *Modern Factor Analysis.* 3rd edition. Chicago, IL: University of Chicago Press; 1976.
49. Podsakoff P, MacKenzie S, Lee J-Y: **Common method biases in behavioral research: a critical review of the literature and recommended remedies.** *Journal of Applied Psychology* 2003, **88:**879–903.
50. Corbett K, Gonzales R, Leeman-Castillo B, Flores E, Maselli J, Kafadar K: **Appropriate antibiotic use: Variation in knowledge and awareness by Hispanic ethnicity and language.** *Prev Med* 2005, **40:**162–169.
51. Cho H, Hongb S, Parkc S: **Knowledge and beliefs of primary care physicians, pharmacists, and parents on antibiotic use for the pediatric common cold.** *Social Science & Medicine* 2004, **58:**623–629.
52. Belongia E, Naimi T, Gale C, Besser R: **Antibiotic use and upper respiratory infections: a survey of knowledge, attitudes, and experience in Wisconsin and Minnesota.** *Prev Med* 2002, **34:**346–352.

53. Larson E, Dilone J, Garcia M, Smolowitz J: **Factors which influence Latino community members to self-prescribe antibiotics.** *Nursing Research* 2006, **55**:94–102.
54. Burge S, White D, Bajorek E, Bazaldua O, Trevino J, Albright T, Wright F, Cigarroa L: **Correlates of medication knowledge and adherence: findings from the residency research network of south Texas.** *Fam Med* 2005, **37**:712–718.

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Chapter 8: Modelling of the PAPA Instrument

Title: Assessing Factors Underlying Antibiotics Use in Children in Saudi Arabia: Modelling of the Parental Perception on Antibiotics (PAPA) Scales.

Ready to be submitted

Contribution of authors:

Author AA designed the study and directed its implementation, including data collection, analysis and interpretation, as well as critical discussion of the findings. Author CH helped in the design and conduction of the study and its analysis, and helped in drafting the article by reviewing it and revising it critically for important intellectual content. AY assisted in data collection and drafting the manuscript by reviewing it and revising it critically for important intellectual content. Authors XH and JS assisted in drafting the manuscript by reviewing it and revising it critically for important intellectual content. All authors approved the final version of the manuscript. In addition, all authors certify that they have participated sufficiently in the work, they all believe in its overall validity and, they all take public responsibility for appropriate portions of its content.

ABSTRACT:

Antibiotics overuse is a global public health issue that needs to be investigated. This study aims to assess the factors influencing the use of antibiotics in children especially with upper respiratory tract infections. Measures: The Parental Perceptions on Antibiotics (PAPA) instrument was used. The instrument measures parent related aspects regarding antibiotics, including: Knowledge and beliefs, behavior, sources of health-related information, adherence to antibiotics doses in children, and awareness about antibiotics resistance. Participants were parents of children younger than 12 years old recruited from primary schools parental meetings in the Eastern Province of Saudi Arabia from September 2012 to January 2013. 1104 parents are included in the study (52% were mothers). Purposeful Selection of Covariates (PSC) was used to build general linear models to analyze the factors influencing the parents' use of antibiotics in children. After completing the PSC process, 5 multivariable general linear models were produced (one for each factor). This study shows the risk factors associated with the psychosocial constructs underlying the parental use of antibiotics in children in Saudi Arabia. The PAPA instrument can be used in other studies to establish its utility in measuring the aspects influencing antibiotic use.

Keywords: Antibiotics use, Parents, Multivariable Models, Saudi Arabia.

BACKGROUND

Antibiotics are powerful agents targeted to treat bacterial infections, leading to a reduction in the mortality and morbidity rates worldwide (Teng, Leong, Aljunid, & Cheah, 2004). Since the introduction of antibiotics in the 1940s their use has increased steadily around the world. With this increased usage, the potential of inappropriate use, such as using antibiotics to treat viral infections, has also increased (Ahmed & Al-Saadi, 2005; Al-Faris & Al-Taweel, 1999; Cebotarenco & Bush, 2008; Irshaid, Al-Homrany, Hamdi, Adjepon-Yamoah, & Mahfouz, 2004; JETACAR, 1999; Mainous, Hueston, Davis, & Pearson, 2003; Simasek & Blandino, 2007; Simoes, et al., 2006). One common inappropriate use of antibiotics is in the treatment of viral Upper Respiratory Tract Infections (URTIs), the most common infections around the world (Bhasin, Budden, Ketkar, & Pawar, 2002; Teng, et al., 2004; West, 2002). A substantial amount of this inappropriate use of antibiotics is in children (Huang, et al., 2007). This significant global public health issue needs to be addressed and managed.

Many countries around the world have inadequate control over the distribution of antibiotics. In these countries antibiotics can be purchased over-the-counter without a doctor's prescription, Saudi Arabia is one of these countries (Bin Abdulhak, et al., 2011). An important implication of over-the-counter purchase of antibiotics is that it puts the decision about the appropriateness of using antibiotics to treat infections in the hands of the patients (consumer), or in the case of children, the guardian. However, if antibiotics are used inappropriately (i.e. overuse) this may lead to several harmful implications, including: the development of antibacterial resistance (R. Green, 2006; Sorkhou, et al., 2002; Teng, et al., 2004) the development of side-effects such as gastrointestinal effects (Irshaid, et al., 2004), and rising the burden of chronic diseases which leads to raising the cost of health services

(Emanuele, 2010; Mora, et al., 2002; West, 2002).

Several studies around the world have attempted to assess the factors influencing the overuse of antibiotics at the policy level, community level, and at the health professionals level. Factors influencing health professionals include: parental pressure (Huang, et al., 2007; Paluck, et al., 2001), lack of health education (Davey, Pagliari, & Hayes, 2002), and lack of patient-doctor interaction (Butler, et al., 2001). Factors related to policy controls include regulations allowing or restricting access to antibiotics.

Psycho-social factors influencing Patients'/parents' overuse of antibiotics include: attitudes regarding antibiotics use (Belongia, Naimi, Gale, & Besser, 2002; Borg & Scicluna, 2002), knowledge and beliefs regarding antibiotics (Borg & Scicluna, 2002; Cebotarenco & Bush, 2008), behaviors such as self-medication (Akici, Kalaca, Ugurlu, & Oktay, 2004), parent's or patients' adherence to antibiotics (Goff, Mazor, Meterko, Dodd, & Sabin, 2008), and awareness about antibiotics resistance (Alumran, Hurst, & Hou, 2011; Brooks, Shaw, Sharp, & Hay, 2008). This study focuses in the patient/parent related psychosocial factors.

One of the previous barriers to studying the psychosocial factors relating to antibiotic overuse has been the lack of a validated instrument to measure these constructs (Alumran, Hou, & Hurst, 2012; Alumran, et al., 2011). However, Alumran, Hou, and Hurst recently developed (2013b) and psychosocially validated (Alumran, Hou, & Hurst, 2013a; Alumran, Hou, Sun, Yousef, & Hurst, 2014) an instrument able to measure the constructs underlying antibiotic use in children, the PAPA instrument. This study aims to evaluate the factors influencing parental use of antibiotics in Saudi Arabia in children with Upper Respiratory Tract Infections (URTIs) using the PAPA instrument.

MATERIALS AND METHODS

Participants: sample size

Like many analysis containing a large number of variables, multivariable regression analysis is generally too complex to prospectively power especially when little is known about risk factors influencing antibiotic use in children. We used two 'rule of thumb' approaches to select the sample size in this study. First, the rule of thumb advocated by Comrey and Lee (1992) (Comrey & Lee, 1992) was used, where 100= fair, 200=good, 500= very good, and >1000= excellent. The second approach used is the one promoted by Green (1991) (S. Green, 1991) to determine multivariable linear regression sample sizes, which is: $N > 50 + 8$ m (where m is the number of independent variables). Further, we inflated sample size because of a likely clustering design effect.

This is a cross-sectional study design using a preliminary-validated questionnaire (Alumran, et al., 2013a; Alumran, et al., 2014). The questionnaire was distributed to parents of children younger than 12 years old in primary schools parental meeting in the Eastern Province of Saudi Arabia in September 2012 to January 2013. Participants' consent was implied in the return of the completed questionnaire as shown in the questionnaire's cover page. Only questionnaires completed by one of the parents or a legal guardian were included in the study. 7 questionnaires were excluded because they were completed by someone other than the parent or guardian. 1104 questionnaires completed by parents were included in the study (79% of those distributed).

Measures:

The PAPA instrument (Alumran, et al., 2014) is a 33-items instrument that measures the psychosocial factors influencing the overuse of antibiotics in children, especially with upper respiratory tract infections. Parents were asked to rate on a 5-point Likert scale ranging from *strongly disagree* to *strongly agree* or from *never* to *always*, depending on the nature of the item. The development and preliminary validation of the PAPA instrument was reported elsewhere (Alumran, et al., 2013a, 2013b) and the construct validity of the instrument was reported in (Alumran, et al., 2014).

The questionnaire also measured parents' demographic characteristics and their children's health-related history. Demographic information included: parent's gender, number of girls and boys in the family, parents health training, parent's age, parents employment status and education levels, parent's geographical background, when the parent moved to the Eastern Province, and parent's monthly income. Child's health-related history information includes: the number of cold episodes and antibiotics used for the youngest child during the last year (ranging from never to more than 6 times a year), and whether any of the children in the family has ever had a serious infectious disease or a chronic disease.

The PAPA instrument includes five scales: Knowledge and beliefs (10 items); Behaviors scale (5 items); Antibiotics Adherence (5 items); Seeking information (7 items); and Awareness about antibiotics resistance (4 items). For each scale the score is gained by using the loadings given in the confirmatory factor analysis (Alumran, et al., 2014).

Procedure:

This is a cross-sectional study using a previously developed (Alumran, et al., 2013b) and fully validated instrument (Alumran, et al., 2013a)(Alumran, et al., 2014). Ethical clearances were obtained from the Department of Development and Planning in the Ministry of Education in the Eastern Province in Saudi Arabia (Ethical approval number: 33505889) and Queensland University of Technology (Ethical approval number: 1200000022).

Statistical analysis:

All data analysis was conducted using Stata SE/v.12: (Stata, 2011). Purposeful Selection of Covariates (Hosmer, Lemeshow, & May, 2008) was used to conduct the analysis using general linear models. Purposeful selection of covariates allows for detection of, and adjustment for, confounders. In the present study, a confounder was identified as a predictor that altered the model βs by at least 35% when added to the model. All the standard errors were adjusted for schools clusters using robust estimators. General linear models were used to obtain both crude and adjusted association for each outcome (the 5 PAPA scales) in the study. Model adequacy was assessed based on model fit (adjusted R^2), significance (F-test) and residual analysis.

RESULTS

Parents' baseline characteristics are shown in **Table 8.1**. Parents were aged between 19 and 72 years (mean= 38, SD= 8) and 52% were mothers. Only 10% of the parents reported health training and more than half of the sample are employed (57%), 2% unemployed, and 28% were housewives. Most parents reported education at the Diploma or Bachelor degrees (62.7%), only 1% of the parents are illiterate (where they filled the survey with the investigator's assistance). The largest proportion of

parents in the study was originally from the Eastern Province (44%), followed by the Southern and Central Provinces (17% and 15% respectively), and 13% are non-Saudis. A majority of parents not originally from the Eastern Province reported moving there in their adulthood (30% of all parents). The mode reported monthly income in the study sample is from 4000 to 11,999 SR (≈ 1,000 to 2,999 USD) representing 33% of the sample, followed by 12,000 to 21,999 SR (≈ 3,000 to 5,799 USD) (32%). Summary statistics of the psychosocial scales in the instrument are available in **Table 8.2.**

Table 8.1 – Parents' Baseline Characteristics

Variable	Value	Freq.	%
Parent	Mother	574	51.99
	Father	530	48.01
	Total	**1101**	**100.0**
Health Trained	Yes	115	10.42
	No	989	89.58
	Total	**1104**	**100.0**
Employment	Employed	632	57.35
	Unemployed	21	1.91
	Student	10	0.91
	Housewife	313	28.40
	Private Business	90	8.17
	Retired	36	3.27
	Total	**1102**	**99.8**
Education	Illiterate	11	1.0
	No Formal Certificate	30	2.74
	Intermediate School Certificate	54	4.93
	High School Certificate	212	19.34
	Diploma or Bachelor	687	62.68
	Higher Degree	102	9.31
	Total	**1096**	**99.3**
Geographical background	Eastern Province	485	44.25
	Western Province	83	7.57
	Central Province	164	14.96
	Northern Province	40	3.65
	Southern Province	185	16.88
	Non-Saudi	139	12.68
	Total	**1096**	**99.3**
Move to eastern province	Childhood	212	20.00
	Adolescent	40	3.77
	Adulthood	340	30.08
	NA	468	42.15
	Total	**1060**	**96.0**
Monthly income	< 4000 SR (<US 999)	109	9.8
	4000 - 11,999 SR (US 1,000 - 2,999)	371	33.4
	12,000 - 21,999 SR (US 3,000 - 5,799)	356	32.0
	22,000 - 34,999 SR (US 5,800 - 9,299)	168	15.1
	>35,000 SR (> US 9,300)	62	5.6
	Total	**1066**	**95.9**
Age		Mean= 38	SD= 8

This table present frequencies and percentages for all of the variables unless stated otherwise

Table 8.2 – Summary Statistics of the Psychosocial Scales and Spearman's Coefficient of Each Scale with the Number of Antibiotics Use

	Mean	Median	SD	Range	Spearman's correlation
KB	23.5	23.6	6.1	32.44	-0.3010
B	19.6	20.9	3.7	18.34	-0.1189
AD	29.9	30.8	7.4	32.352	-0.1413
SI	27.4	28.4	8.7	40.532	0.0180
ABR	13.8	14	2.6	15.256	-0.0429

From the child health-related information, thirty-nine (3.5%) parents reported having a child who have had serious infectious diseases in the past, including 15 cases of chicken pox, 8 cases of flu (including swine flu), and 3 cases of mumps and measles. 141 (12.8%) of parents reported having a child with a chronic disease, such as: 58 cases of asthma, 14 cases of eczema, 12 cases of blood disorders such as: Thalassemia and Anemia (including: Hemolytic anemia and Sickle cell anemia), allergies were reported in 13 children (including skin allergies), 8 cases of diabetes were reported, Glucose-6-phosphate dehydrogenase (G6PD) deficiency was reported in 9 children in the study, and 5 cases of heart diseases were reported including arrhythmia.

For each scale an extensive analysis took place to develop the best general linear model for that specific scale. After conducting Purposeful Selection of Covariates, five models are produced. All models are adjusted for clusters of schools. The F-test and p-values are from the models with the clustering effect, but the adjusted R^2 is for the models not adjusted for the clustering effect. Crude and adjusted associations for each outcome are given in: (1) The Knowledge and beliefs model shown in Table 8.3; (2) Behaviours model shown in Table 8.4; (3) Antibiotics

adherence model in shown in Table 8.5; (4) Seeking Information shown in Table 8.6; and (5) Awareness about antibiotics resistance shown in Table 8.7. Estimated marginal means were calculated using post hoc tests (Table 8.8), these show the confounder-adjusted means in the categorical variables.

In the knowledge and beliefs scale a higher score means better knowledge regarding antibiotics; for behaviours scale a higher score means better behaviour regarding antibiotics use; for Antibiotics Adherence a higher score in this scale means better antibiotics adherence; for Seeking Information scale the higher the score means more information seeking; and finally for the Awareness about Antibiotics Resistance scale a higher score means better awareness regarding antibiotics resistance.

All models in the study were highly significant. Knowledge and beliefs: F-test= 9.18, $P<0.01$, Adjusted $R^2= 0.1162$; Behaviours: F-test= 5.88, $P<0.01$, Adjusted $R^2= 0.0808$; Adherence: F-test= 18.53, $P<0.01$, Adjusted $R^2= 0.1088$; Seeking information: F-test= 11.86, $P<0.01$, Adjusted $R^2= 0.0212$; Awareness about antibiotics resistance: F-test= 19.64, $P<0.01$, Adjusted $R^2= 0.0433$.

Knowledge and beliefs model:

Knowledge and beliefs about appropriate use of antibiotics in children is influenced by several factors (**Table 8.3**). The analysis revealed that fathers have lower knowledge and beliefs about antibiotics and their appropriate use compared to mothers (β_{Father}: -2.27; CI: -3.47, -1.06; P<0.01). Parents trained in a health field have better knowledge and beliefs about the appropriate use of antibiotics in children ($\beta_{NonHealthTrained}$: -1.81; CI: -3.04, -0.59; P<0.01), estimated marginal means in **Table 8.8** show the difference between the adjusted knowledge and beliefs mean of parents with health training: 25.3 compared to parents without health training: 23.4, with the average mean score of knowledge and beliefs being 23.5 (**Table 8.2**). Furthermore, parents' age was shown to influence their knowledge and beliefs about the appropriate use of antibiotics in children, with parental knowledge and beliefs increasing with age (β_{Age}: 0.08; CI: 0.04, 0.13; P<0.01).

Table 8.3 – 'Knowledge and Beliefs' Model
[F-test= 9.18, p-value<0.001, Adjusted R^2= 0.1162]

Effect	Knowledge and Beliefs β_{crude}	Knowledge and Beliefs $\beta_{adjusted}$	95%CI ($\beta_{adjusted}$)	
Fathers	**-0.632**	-2.269**	-3.474	-1.065
Number of Girls	0.138			
Number of Boys	**-0.497***			
Parent not health trained	**-2.779*****	-1.813**	-3.039	-0.587
Age	**0.084****	0.084**	0.036	0.132
Employment	χ^2_{LR}= 4.93	χ^2_{LR}= 6.39		
Employed	**Ref**			
Unemployed	**-1.766**			
Student	**-0.449**			
Housewife	**-0.595**			
Private business	**-1.014**			
Retired	**0.215**			
Education	χ^2_{LR}= 80.82***	χ^2_{LR}=21.28**		
Illiterate	**Ref**			
No formal certificate	**0.753**	1.408	-4.667	7.483
Intermediate School	**-0.185**	1.026	-3.698	5.749
High school	**1.399**	2.064	-2.948	7.076
Diploma or Bachelor	**2.809**	3.393	-1.324	8.110
Higher Degree	**5.166**	5.129	0.005	10.253
Geographical background	χ^2_{LR}= 48.94***	χ^2_{LR}= 3.55		
Eastern Province	**Ref**			
Western Province	**1.335**			
Central province	**1.398**			
Northern province	**0.581**			
Southern province	**-0.206**			
Non-Saudi	**-0.407**			
Move to Eastern Province				
Childhood	Ref			
Adolescent	0.054	0.053	-2.732	2.838
Adulthood	0.293	0.531	-0.535	1.596
Eastern Province Origin	-0.344	-0.052	-1.009	0.905
Monthly income	χ^2_{LR}= 323.61***	χ^2_{LR}= 21.48***		
Low	**Ref**			
Medium-low	**0.552**	0.640	-0.934	2.214
Medium	**1.760**	1.146	-0.188	2.479
Medium High	**4.236**	3.071**	1.325	4.817
High	**4.204**	3.582**	1.493	5.668
Cold Episodes/year	χ^2_{LR}= 104.10***	χ^2_{LR}= 28.49***		
Never	**Ref**			
Once a year	**-0.971*****	-0.955	-3.438	1.528
2 – 3 times a year	**-1.959**	-2.183	-4.711	0.345
4 – 6 times a year	**-3.034**	-3.260*	-6.112	-0.408
> 6 times a year	**-4.480**	-4.107*	-7.256	-0.958
No serious infectious disease	-0.877			
No chronic disease	**1.475****	1.162*	0.134	2.189

* P<0.05; ** P<0.01; *** P<0.001; Crude associations in bold were significant at the 0.2 level

Behaviours model:

The parents' behaviour regarding the use of antibiotics in children is influenced by several factors (**Table 8.4**). Relative to mothers, fathers were shown to have poorer behaviour in regards to the appropriate use of antibiotics (β_{father}: -1.80; CI: -2.56, -1.04; P<0.01). Moreover, the family's monthly income influences the parental behaviour significantly (χ^2_{LR}= 21.33, P<0.01); parents with med-high and high income have better behaviour regarding the use of antibiotics compared to low income parents ($\beta_{med\text{-}high}$: 1.32; β_{high}: 1.83, both P<0.05). Several variables are identified as confounders in the parents' behaviour, including: age, employment, and when the parent move to the eastern province, geographical background was significant at the crude level of analysis, but after adjusting factors, geographical background was no longer significant.

Table 8.4 – 'Behaviors' Model
[F-test= 5.88, p-value<0.0001, Adjusted R^2= 0.0808]

	Behaviors		95%CI	
Effect	β_{crude}	$\beta_{adjusted}$	($\beta_{adjusted}$)	
Father	**-1.618*** **	-1.802***	-2.564	-1.039
Number of Girls	**0.349***			
Number of Boys	**-0.433****			
Parent not health trained	0.229			
Age	-0.007	0.012	-0.026	0.051
Employment	χ^2_{LR}= 27.74***	χ^2_{LR}= 15.43**		
Employed	**Ref**			
Unemployed	**-0.637****	0.028	-1.268	1.325
Student	**0.111**	-0.313	-4.261	3.635
Housewife	**0.694**	-0.048	-0.704	0.608
Private business	**-1.559**	-1.651	-2.642	-0.659
Retired	**0.453**	0.539	-0.761	1.839
Education				
Illiterate	Ref			
No formal certificate	0.692			
Intermediate School	0.756			
High school	0.345			
Diploma or Bachelor	0.665			
Higher Degree	0.225			
Geographical background	χ^2_{LR}= 44.97***	χ^2_{LR}= 12.42*		
Eastern Province	**Ref**			
Western Province	**-0.255***	-0.911	-2.651	0.829
Central province	**0.346**	-0.619	-2.179	0.942
Northern province	**-1.348**	-1.964	-4.654	0.726
Southern province	**-0.021**	-0.624	-2.095	0.848
Non-Saudi	**-0.763**	-1.534	-3.402	0.335
Move to Easter Province				
Childhood	Ref			
Adolescent	-0.522	-0.069	-1.959	1.821
Adulthood	0.009	0.340	-0.555	1.236
Eastern Province Origin	0.139	-0.218	-1.709	1.272
Monthly income	χ^2_{LR}= 256.96***	χ^2_{LR}= 21.33***		
Low	**Ref**			
Medium-low	**0.3887****	0.079	-0.941	1.099
Medium	**0.9493**	0.714	-0.202	1.629
Medium High	**1.319**	1.321*	0.237	2.404
High	**1.476**	1.827**	0.709	2.944
Cold episodes/year				
Never	Ref			
Once a year	-0.121			
2 – 3 times a year	0.057			
4 – 6 times a year	-0.376			
> 6 times a year	-0.404			
No serious infectious disease	**-0.994***			
No chronic disease	-0.258			

P<0.05; ** P<0.01; *** P<0.001; Crude association in bold were significant at the 0.2 level

Adherence model:

Parents' adherence to antibiotics doses is influenced by several factors (**Table 8.5**). In this model, fathers tend to adhere less to appropriate antibiotic doses than mothers (β_{father}: -1.95; CI: -3.04, -0.85; P<0.01). Also, with the increase in the number of boys in the family a decrease in parents' adherence to antibiotic doses occurs (β_{Boys}: -0.44; CI: -0.86, -0.03; P<0.05). Furthermore, parents trained in health fields tend to adhere more to appropriate antibiotic doses in their children ($\beta_{NonHealthTrained}$: -1.88; CI: -3.25, -0.51; P<0.01).

Compared to parents from the Eastern Province, parents from the Northern Province had significantly lower adherence ($\beta_{NorthernProvince}$: -3.92; CI: -7.20, -0.65; P<0.05). The highest and medium income classes exhibited significantly better adherence relative to the lowest income group (β_{med}: 2.47; $\beta_{med\text{-}high}$: 4.53; β_{high}: 4.24, all P<0.01). In addition, age, education, and when the parent moved to the Eastern Province were all considered confounders on the parents' adherence to appropriate antibiotic doses in children, adding these confounders influenced on the parents geographical background.

Table 8.5 – 'Adherence to Antibiotic Doses' Model
[F-test= 18.53, p-value<0.0001, Adjusted R^2= 0.1088]

	Adherence to antibiotic doses		95%CI ($\beta_{adjusted}$)	
Effect	β_{crude}	$\beta_{adjusted}$		
Fathers	**-1.184***	-1.945**	-3.043	-0.848
Number of Girls	0.318			
Number of Boys	**-0.646**	-0.440*	-0.855	-0.025
Parent not health trained	**-2.899**	-1.881**	-3.251	-0.512
Age	**0.048**	0.046	-0.007	0.098
Employment				
Employed	Ref			
Unemployed	-0.148			
Student	-1.661			
Housewife	-0.3773			
Private business	-0.094			
Retired	-1.509			
Education	χ^2_{LR}= 57.39***	χ^2_{LR}= 28.88***		
Illiterate	**Ref**			
No formal certificate	**0.747**	-1.110	-7.609	5.389
Intermediate School	**-0.955**	-1.161	-8.535	6.212
High school	**2.583**	1.892	-3.999	7.784
Diploma or Bachelor	**5.067**	3.398	-2.496	9.291
Higher Degree	**4.926**	2.286	-4.035	8.607
Geographical background	χ^2_{LR}= 31.34***	χ^2_{LR}= 17.95**		
Eastern Province	**Ref**			
Western Province	**1.540**	0.630	-1.434	2.694
Central province	**2.528**	0.371	-1.924	2.666
Northern province	**-1.245**	-3.924*	-7.199	-0.648
Southern province	**-0.868**	-1.743	-4.054	0.569
Non-Saudi	**-1.364**	-1.023	-3.525	1.479
Move to eastern province				
Childhood	Ref			
Adolescent	-0.561	1.186	-1.664	4.036
Adulthood	-0.989	-0.090	-1.582	1.402
Eastern Province Origin	-0.749	-0.356	-2.499	1.788
Monthly income	χ^2_{LR}= 327.92***	χ^2_{LR}= 31.26***		
Low	**Ref**			
Medium-low	**1.745**	0.870	-0.828	2.569
Medium	**3.980**	2.465**	0.799	4.131
Medium-high	**6.185**	4.527***	2.285	6.769
High	**5.468**	4.242***	2.138	6.345
Cold episodes/year				
Never	Ref			
Once a year	0.546			
2 – 3 times a year	0.148			
4 – 6 times a year	-0.602			
> 6 times a year	-1.540			
No serious infectious disease	-0.639			
No chronic disease	**0.962**			

P<0.05; ** P<0.01; *** P<0.001; Crude association in bold were significant at the 0.2 level

Seeking information:

Parents' tendency to seek health-related information is influenced by several factors (**Table 8.6**). The older the parents, the less health related information they seek (β_{Age}: -0.08; CI: -0.14, -0.02; P<0.01). All intermediate income categories, including: med-low, medium, and med-high, exhibited higher eagerness to seek health related information compared to the lowest income ($\beta_{med\text{-}low}$: 2.51; β_{med}: 2.48; $\beta_{med\text{-}high}$: 2.37; all P<0.05).

Parents of children who have had a serious infectious disease in the past are more eager in seeking health-related information ($\beta_{NoSeriousInfectiousDisease}$: -3.99; CI: -6.39, 1.60; P<0.01). Estimated marginal means in **Table 8.8** show the difference between the adjusted mean of Seeking information scale for parents who have not experienced a serious infectious disease in any of their children in the past: 27.3, compared to parents who have experienced a serious infectious disease in one of their children in the past: 31.3, with the average mean score of seeking information being 27.4 (**Table 8.2**).

In addition, parent's gender, number of girls, number of boys, when the parent moved to the Eastern Province, and the number of cold episodes occurring in the past year for the youngest child were all identified as confounders in the parents' tendency to seek health-related information model.

Table 8.6 – 'Seeking Information' Model
[F-test= 11.86, p-value<0.0001, Adjusted R^2= 0.0212].

	Seeking Information		95%CI ($\beta_{adjusted}$)	
Effect	β_{crude}	$\beta_{adjusted}$		
Fathers	**-1.349**	-0.529	-2.187	1.130
Number of Girls	**0.518**	0.224	-0.479	0.926
Number of Boys	**-0.556**	-0.506	-1.117	0.105
Parent not health trained	-0.314			
Age	**-0.123**	-0.081**	-0.137	-0.024
Employment				
Employed	Ref			
Unemployed	0.863			
Student	2.538			
Housewife	0.554			
Private business	-1.596			
Retired	-1.820			
Education	χ^2_{LR}= 8.35	χ^2_{LR}= 8.10		
Illiterate	**Ref**			
No formal certificate	**-2.141**			
Intermediate School	**-1.313**			
High school	**-1.374**			
Diploma or Bachelor	**0.148**			
Higher Degree	**-1.359**			
Geographical background				
Eastern Province	Ref			
Western Province	0.250			
Central province	0.962			
Northern province	2.287			
Southern province	-0.477			
Non-Saudi	-1.091			
Move to Eastern Province	χ^2_{LR}= 266.25***	χ^2_{LR}= 2.06		
Childhood	**Ref**			
Adolescent	**-0.962**	-2.067	-5.780	1.646
Adulthood	**-1.414**	-1.006	-2.504	0.491
Eastern Province Origin	**-0.686**	-0.445	-1.874	0.984
Monthly income	χ^2_{LR}= 264.76***	χ^2_{LR}= 5.25		
Low	**Ref**			
Medium-low	**2.036**	2.506**	0.669	4.343
Medium	**1.919**	2.482*	0.339	4.625
Medium High	**1.330**	2.372*	0.313	4.430
High	**0.375**	2.807	-0.057	5.671
Cold episodes/year	χ^2_{LR}= 57.51***	χ^2_{LR}= 3.95		
Never	**Ref**			
Once a year	**1.709**	1.313	-1.526	4.152
2 – 3 times a year	**2.292**	1.716	-1.045	4.477
4 – 6 times a year	**3.423**	2.789	-0.480	6.059
> 6 times a year	**3.463**	2.090	-1.878	6.058
No serious infectious disease	**-2.777**	-3.998**	-6.395	-1.602
No chronic disease	0.451			

* P<0.05; ** P<0.01; *** P<0.001; Crude association in bold were significant at the 0.2 level

Awareness about antibiotics resistance model:

Parents' awareness about antibiotics resistance is influenced by several factors (**Table 8.7**). In this model, fathers tend to have less awareness about antibiotics resistance (β_{father}: -0.47; CI: -0.92, -0.02; P<0.05). Also, parents trained in health-related fields are more aware about antibiotics resistance ($\beta_{NonHealthTrained}$: -0.65; CI: -1.18, -0.12; P<0.05). Parents working in a private business are less aware about antibiotics resistance than employed parents ($\beta_{PrivateBusiness}$: -1.11; CI: -1.89, -0.32; P<0.01). In addition, higher parents' monthly income is associated with an increased awareness about antibiotics resistance (β_{high}: 1.58; CI: 0.50, 2.66; P<0.01). Furthermore, parents' geographical background and when they moved to the Eastern Province are confounders in the parents' awareness about antibiotics resistance, these two covariates confounded parent's employment and monthly income, in particular.

Table 8.7 – 'Awareness about Antibiotics Resistance' Model
[F-test= 19.64, p-value<0.0001, Adjusted R^2= 0.0433]

	Awareness about Antibiotics Resistance		95%CI	
Effect	β_{crude}	$\beta_{adjusted}$	($\beta_{adjusted}$)	
Fathers	-0.133	-0.472*	-0.924	-0.019
Number of Girls	0.011			
Number of Boys	-0.099			
Parent not health trained	**-0.966*** **	-0.654*	-1.184	-0.125
Age	**0.013**			
Employment	χ^2_{LR}= 18.35**	χ^2_{LR}= 14.66*		
Employed	**Ref**			
Unemployed	**0.1428***	0.032	-1.005	1.070
Student	**-0.519**	-0.692	-2.021	0.636
Housewife	**-0.344**	-0.482	-0.988	0.023
Private business	**-1.171**	-1.106**	-1.893	-0.319
Retired	**-0.152**	-0.132	-1.031	0.768
Education	χ^2_{LR}= 22.76***	χ^2_{LR}= 12.91*		
Illiterate	**Ref**			
No formal certificate	**-0.564***			
Intermediate School	**0.167**			
High school	**-0.340**			
Diploma or Bachelor	**0.337**			
Higher Degree	**0.951**			
Geographical background	χ^2_{LR}= 12.35*	χ^2_{LR}= 3.13		
Eastern Province	**Ref**			
Western Province	**0.833**	0.335	-0.878	1.547
Central Province	**0.358**	-0.191	-1.078	0.696
Northern Province	**0.413**	-0.132	-1.270	1.006
Southern Province	**0.552**	0.118	-0.876	1.112
Non-Saudi	**0.440**	0.448	-0.564	1.460
Move to Eastern Province	χ^2_{LR}= 191.64***	χ^2_{LR}= 0.45		
Childhood	**Ref**			
Adolescent	**0.293***	0.295	-0.655	1.244
Adulthood	**0.0003**	-0.001	-0.432	0.430
NA	**-0.521**	-0.420	-1.262	0.422
Monthly income	χ^2_{LR}= 179.43***	χ^2_{LR}= 10.97*		
Low	**Ref**			
Medium-low	**0.262*** **	0.094	-0.632	0.820
Medium	**0.615**	0.508	-0.361	1.378
Medium High	**0.536**	0.466	-0.462	1.393
High	**1.623**	1.577**	0.496	2.658
Cold episodes/year				
Never	Ref			
Once a year	0.076			
2 – 3 times a year	-0.167			
4 – 6 times a year	-0.287			
> 6 times a year	-0.253			
No serious infectious disease	-0.235			
No chronic disease	0.017			

P<0.05; ** P<0.01; *** P<0.001; Crude association in bold were significant at the 0.2 level

Table 8.8 – Estimated Marginal Means for the Categorical Variables in the 5 Models in the Study

	Variable	KB	B	AD	SI	AAB
Parent	Mother	24.747	20.504	31.100	27.713	14.033
	Father	22.478	18.702	29.154	27.184	13.562
Health trained	Yes	25.253	-	31.822	-	14.388
	No	23.440	-	29.940	-	13.733
Employment	Employed	-	19.752	-	-	14.037
	Unemployed	-	19.780	-	-	14.069
	Student	-	19.439	-	-	13.344
	Housewife	-	19.704	-	-	13.555
	Private business	-	18.101	-	-	12.931
	Retired	-	20.291	-	-	13.905
Education	Illiterate	20.510	-	27.489	-	
	No formal certificate	21.918	-	26.379	-	
	Intermediate School	21.535	-	26.327	-	
	High school	22.574	-	29.381	-	
	Diploma or Bachelor	23.903	-	30.886	-	
	Higher Degree	25.639	-	29.775	-	
Geographical background (province)	Eastern	-	20.134	30.603	-	13.745
	Western	-	19.222	31.233	-	14.079
	Central	-	19.515	30.974	-	13.554
	Northern	-	18.170	26.679	-	13.612
	Southern	-	19.510	28.860	-	13.863
	Non-Saudi	-	18.600	29.580	-	14.193
Move to Eastern Province	Childhood	23.489	19.614	30.291	28.047	13.978
	Adolescent	23.542	19.544	31.477	25.980	14.272
	Adulthood	24.019	19.954	30.201	27.040	13.977
	NA	23.437	19.395	29.935	27.602	13.557
Monthly income	Low	22.314	19.036	28.026	25.195	13.431
	Medium-low	22.954	19.115	28.897	27.701	13.525
	Medium	23.460	19.751	30.491	27.676	13.940
	Medium High	25.385	20.357	32.554	27.566	13.897
	High	25.895	20.863	32.268	28.002	15.008
Cold episodes/year	Never	25.613	-	-	25.789	
	Once a year	24.658	-	-	27.102	
	2 – 3 times	23.430	-	-	27.504	
	4 – 6 times	22.353	-	-	28.578	
	> 6 times	21.506	-	-	27.878	
Serious infec. disease	Yes	-	-	-	31.302	
	No	-	-	-	27.304	
Chronic disease	Yes	22.636	-	-		
	No	23.797	-	-		

DISCUSSION

The study assessed the parent-related psychosocial aspects influencing the use of antibiotics in children using the PAPA instrument (Alumran, et al., 2014). The parents' psychosocial aspects in the study are: Knowledge and beliefs, Behaviours, Antibiotics Adherence, Seeking information, and Awareness about antibiotics resistance. All of these aspects were tested in this study against a set of demographic and child health-related aspects.

For all PAPA scales, fathers scored lower (worse) than mothers, and higher income parents scored higher than lower income ones. Also, parents with health training scored higher (better) on all scales except behaviours and seeking information scales, where no difference could be identified. In addition, older parents have better knowledge and beliefs about antibiotics and their appropriate use relative to younger parents, and they tend to seek less health-related information.

There were substantial differences between crude and adjusted levels of association in the analysis conducted in this study. The parent's monthly Income was significant at the crude level of association in three models: Behaviours, Seeking information, and Awareness about antibiotics resistance. This predictor stayed significant in all of the models after adjusting for the rest of the covariates in these models, but with a high increase in the effect in all three scales after adjustment.

Whether the parent had had any health-related training was significant in three models (i.e. Knowledge and beliefs, Adherence to appropriate antibiotic doses, and Awareness about antibiotics resistance).

Parents' age group (childhood, adolescent, and adulthood) when they moved to the Eastern Province was not significant in any of the scales at the crude level of association but was included in all of the scales as a confounder. Education was significant at the crude level in the knowledge and beliefs and Antibiotics adherence

models but was no longer significant after adjusting for the rest of the covariates in the model, however, education was retained in both models as a confounder.

Fathers in the current study appear to have lower knowledge and beliefs about the appropriate use of antibiotics in children. This result is consistent with other studies (McNulty, Boyle, Nichols, Clappison, & Davey, 2007) which found that males provided more incorrect information regarding the appropriate use of antibiotics than females. Belongia *et al.* (2002) also found that females have better knowledge and beliefs about the appropriate use of antibiotics in children. In addition, mothers in the current study have better awareness about antibiotic resistance compared to fathers, consistent with findings of McNulty *et al.* (2007). This could be due to the potential association between the parent's gender and their age, however, age was adjusted for in all models in the study. Therefore, age did not influence on the results in this current study. Further studies on interactions among parents' gender in relation to their knowledge and awareness are warranted.

Mothers in the current study were found to have better behaviour in regards to the appropriate use of antibiotics compared to fathers. Consistently, You *et al.* (2008) found that male gender is a predictor of poor behavior in regards to antibiotic use. On the other hand, a study conducted in Sudan by Awad *et al.* (2005) found opposing results, where females in their study have a higher risk of self-medication with antibiotics than males. This might be related to differences between females' education levels in Saudi Arabia and in Sudan, or other social differences between the two communities.

The study revealed that fathers are less adherent to appropriate antibiotic doses in their children. This concurs with results from other studies, which showed that men are less likely to follow correct dosage instructions than women (Mitsi, Jelastopulu, Basiaris, Skoutelis, & Gogos, 2005). In addition, most studies in the

literature assess the adherence in regards to patients (Mitsi, et al., 2005) and none assessed the parental adherence to antibiotics regimens with their children. Parents' use of antibiotics with their children might not be similar to their usage on themselves. Therefore, it is important to measure the parental adherence to antibiotics as part of the psychosocial constructs influencing the use of antibiotics in children.

Consistent with our findings, Belongia (2002) found that older parents have better knowledge and beliefs about antibiotics use. Which could be associated with older parents having more years of experience with antibiotics compared to younger parents, and experience leads to better knowledge and beliefs.

In the current study, parents with higher income have better knowledge and beliefs about the appropriate use of antibiotics in children and better awareness about antibiotic resistance, which is consistent with results from Vanden *et al.* (2003). This is likely to be related to a better access to health information and medical education for parents with higher income compared to lower income parents. However, it is important to note that even after adjusting for education, higher income was still associated with higher knowledge and beliefs.

Several studies in the literature found that patients/parents showed that more inappropriate antibiotic use is associated with lower socioeconomic status, which could be associated with low education levels (Kozyrskyj, et al., 2004; Matuz, et al., 2005). In the present study, we found that education level was sometimes associated at the crude level, but was not a significant predictor in any of the multivariable models. A possible explanation for this is that income is highly associated with education in Saudi Arabia, and that this predictor may be acting as a surrogate of education. On the other hand, other studies found that higher socioeconomic status is associated with inappropriate use of antibiotics (Braun & Fowles, 2000; Vanden Eng,

et al., 2003), which could be because of the parents' mistaken belief that antibiotics treat upper respiratory tract infections therefore reducing the parents time taken off work.

Parents with higher income have better adherence to appropriate antibiotic doses compared to lower income parents. Safran et al. (2002) suggest that lower income patients skip doses to make their prescription last longer, and therefore lower their adherence levels. Although antibiotics in Saudi Arabia are easily obtainable 'over-the-counter' at private pharmacies (Bin Abdulhak, et al., 2011), low income parents may not be able to buy several courses of antibiotics and therefore use older incomplete ones they already have, thus leading to lower adherence levels. On the other hand, Glombiewski *et al.* (2012) found opposing results in their study, where higher income patients have lower adherence to appropriate antibiotic regimens. A possible explanation for this controversy is that in other countries, where antibiotics are not purchasable over-the-counter, the expenses to seek medical advice and get a prescription is not affordable for low income patients as much as it is in higher income patients. Thus, leading lower income patients in these countries to adhere well to their antibiotic regimens to avoid the need to seek medical advice again.

This study found some interesting results about a current and important public health issues; the overuse of antibiotics for non-bacterial infections. This overuse or misuse as some may call it, causes antibacterial resistance strains to spread making the treatment of important severe infections harder to achieve (Levy & Marshall, 2004; Walson, Marshall, Pokhrel, Kafle, & Levy, 2001). This study assessed the risk factors associated with the psychosocial constructs that underpin antibiotic use.

The results of this study show us the risk factors associated with the psychosocial constructs likely to drive antibiotic use in the Saudi Arabian context. The usefulness of the PAPA scales for measuring these constructs in other countries needs to be established.

Once we can understand the psychosocial aspects of antibiotics use, policy and public health interventions can be tailored to address this important public health issue.

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Statement of Contribution of Co-Authors for Thesis by Published Paper

The following is the format for the required declaration provided at the start of any thesis chapter which includes a co-authored publication.

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2. they take public responsibility for their part of the publication, except for the responsible author who accepts overall responsibility for the publication;
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Contributor	Statement of contribution*
Arwa Alumran  30/10/2013	Designed the study and directed its implementation, including data collection, analysis and interpretation, as well as critical discussion of the findings, and drafted the manuscript
Xiang-Yu Hou	Assisted in drafting the manuscript by reviewing it and revising it critically for important intellectual content
Jiandong Sun	Assisted in drafting the manuscript by reviewing it and revising it critically for important intellectual content
Abdullah Yousef	Assisted in data acquisition and drafting the manuscript by reviewing it and revising it critically for important intellectual content
Cameron Hurst	Helped in the design and conduction of the study and its analysis, and helped in drafting the article by reviewing it and revising it critically for important intellectual content

Principal Supervisor Confirmation

I have sighted email or other correspondence from all Co-authors confirming their certifying authorship.

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Name	Signature	Date

Chapter 9: Antibiotics Use in Children

Title: The Parental Use of Antibiotics in Children in Saudi Arabia

Ready to be submitted.

Contribution of authors:

Author AA designed the study and directed its implementation, including data collection, analysis and interpretation, as well as critical discussion of the findings. Author CH helped in the design and conduction of the study and its analysis, and helped in drafting the article by reviewing it and revising it critically for important intellectual content. AY assisted in data collection and drafting the manuscript by reviewing it and revising it critically for important intellectual content. Authors XH and JS assisted in drafting the manuscript by reviewing it and revising it critically for important intellectual content. All authors approved the final version of the manuscript. In addition, all authors certify that they have participated sufficiently in the work, they all believe in its overall validity and, they all take public responsibility for appropriate portions of its content.

Abstract:

Background: The overuse of antibiotics especially in children is becoming one of the most important public health issues worldwide. This study aims to assess the factors underlying the parental use of antibiotics for children in Saudi Arabia.

Methods: This is a cross-sectional study design. 1104 Parents (52% were mothers) of children younger than 12 years old were recruited from schools parental meetings in the Eastern Province of Saudi Arabia. Ordinal logistic regression was used to identify the factors influencing the parental use of antibiotics in children. Risk factors considered included parents' demographic information, child health-related information, along with the PAPA scales, a validated instrument that measures parents' knowledge and beliefs, behaviours, adherence, seeking information, and awareness about antibiotic resistance.

Results: there is a high association between the frequency of cold episodes and the number of antibiotics used for the youngest child in the family during the previous year. Three parent-related psychosocial aspects appeared to be significantly associated with the parents' tendency to use an antibiotic in their children: Knowledge and beliefs, behaviors, and seeking health-related information. Also, parent's geographical background is associated with their use of antibiotics.

Conclusion: the strong association between the number of cold incidence and the amount of antibiotics used suggests an evidence for antibiotic misuse in Saudi Arabia. In addition, to stronger regulations relating to dispensing antibiotics, the Saudi government should implement public health interventions aimed at advocating parents to appropriate use of antibiotics, and the potential dangers in their misuse.

Keywords: Antibiotics use, Parents, Saudi Arabia, Multivariable Models.

INTRODUCTION:

Antibiotics are helpful in treating bacterial infections, but have been widely used inappropriately to treat viral infections such as most Upper Respiratory Tract Infections (URTIs), the most common infections around the world (Bhasin, Budden, Ketkar, & Pawar, 2002; Teng, Leong, Aljunid, & Cheah, 2004; West, 2002). This type of inappropriate use, or overuse is increasingly high in children (Huang, et al., 2007).

In many countries around the world, the distribution of antibiotics is not adequately regulated, where antibiotics can be purchased over-the-counter without a doctor's prescription. In Saudi Arabia, the law states that antibiotics needs doctors' prescription to be dispensed to patients (Bawazir, 1992). However, studies have revealed that pharmacies often do not follow these regulations and a huge amount of antibiotics are dispensed without prescriptions (Al-Hassan, 2011; Bin Abdulhak, et al., 2011). Furthermore, antibiotics are frequently inappropriately dispensed by the pharmacists for viral infections, with and without the patient/parent's request (Bin Abdulhak, et al., 2011).

With the lack of implementation on enforcement of strict regulations on over-the-counter dispensing of antibiotics, the choice of using an antibiotic relies almost entirely on the patient/parent. In such a setting, minimizing inappropriate use can only be through addressing public awareness regarding the use of antibiotics.

The inappropriate use of antibiotics, or overuse, causes several harmful effects both the community level and individual level. These harmful effects include: the development of antibacterial resistance (R. Green, 2006; Sorkhou, et al., 2002; Teng, et al., 2004), the development of preventable adverse drug reactions such as gastrointestinal effects (Al-Hassan, 2011; Irshaid, Al-Homrany, Hamdi, Adjepon-

Yamoah, & Mahfouz, 2004), and raising the burden of chronic diseases which leads to raising the unnecessary expenditure of health services (Emanuele, 2010; Mora, et al., 2002; West, 2002).

Antibiotics resistance is currently one of the most important growing public health issues worldwide, mainly caused by antibiotics overuse (Centers for Disease Control and Prevention, 2009). Antibiotic resistance places both the community and the individual at risk (JETACAR, 1999; Mainous, Hueston, Davis, & Pearson, 2003; Simasek & Blandino, 2007). Teng et al. (2004) assert that the inappropriate use or the overuse of antibiotics to treat viral URTIs is one of the main reasons for the development of antibiotic resistance. Promoting parental judicious use of antibiotics could protect children from bacterial resistance.

Several studies have attempted to evaluate the factors influencing the overuse of antibiotics, focusing on either the community level or the health professionals level. Factors discussed in the literature that are at the health professionals' level include: parental pressure (Huang, et al., 2007; Paluck, et al., 2001), lack of health education (Davey, Pagliari, & Hayes, 2002), and lack of patient-doctor interaction (Butler, et al., 2001). Factors related to the patients and/or parents include: attitudes regarding antibiotics use (Belongia, Naimi, Gale, & Besser, 2002; Borg & Scicluna, 2002), knowledge and beliefs regarding antibiotics (Alumran, Hou, & Hurst, 2012; Borg & Scicluna, 2002; Cebotarenco & Bush, 2007), behaviors such as self-medication (Akici, Kalaca, Ugurlu, & Oktay, 2004), parent's or patients' adherence to antibiotics (Goff, Mazor, Meterko, Dodd, & Sabin, 2008), and awareness about antibiotics resistance (Brooks, Shaw, Sharp, & Hay, 2008). However, an extensive literature review (Alumran, et al., 2012) found that no studies have used a valid and reliable instrument to measure these factors.

This study aims to evaluate the factors influencing the parental use of antibiotics in children in Saudi Arabia. The Parental Perceptions on Antibiotics (PAPA) Scales (Alumran, Hou, Sun, Yousef, & Hurst, 2014) was used to assess parental psychosocial factors influencing this overuse, as well as other demographic factors and children's health-related history factors.

MATERIALS AND METHODS

Study design:

The study was conducted in the Eastern Province of Saudi Arabia using a cross-sectional study design from September 2012 to January 2013.

Participants:

Parents of children younger than 12 years old were recruited from primary schools' parental meetings in the Eastern Province of Saudi Arabia. Schools in Saudi Arabia are single sex schools. Stratified random sampling was used in this study where 14 girls schools (8 public and 6 private) were included and 19 boys schools (8 public and 11 private).

Participants' consent was implied in the return of the completed questionnaire as shown in the questionnaire's cover page. Only questionnaires completed by one of the parents or a legal guardian were included in the study. Therefore, 7 questionnaires were excluded since they were completed by grandfathers, brothers, sisters, and/or aunts. 1104 questionnaires completed by parents were included in the study.

Two 'rule of thumb' approaches were used to select the sample size in this study. First, the rule of thumb advocated by Comrey and Lee (1992), which states

that 100= fair, 200=good, 500= very good, and >1000= excellent. The second approach used is to determine regression sample sizes, promoted by Green (1991), which is: N > 50 + 8 m (where m is the number of independent variables). Sample size was inflated because of a likely clustering effect.

Measures:

The Parental Perceptions on Antibiotics (PAPA) instrument (Alumran, et al., 2014), was used to measure the psychosocial factors influencing the parental use of antibiotics in children with URTIs. The PAPA instrument consists of 33 items distributed across five scales. The scales in the instrument are: (1) *Knowledge and beliefs* includes 10 items, (2) *Behaviors* scale has 5 items, (3) *Antibiotics Adherence* includes 5 items, (4) *Seeking information* is a 7-items scale, and (5) *Awareness about antibiotics resistance* includes 4 items. Parents were asked to rate on 5-point Likert scale ranging from *strongly disagree* to *strongly agree*, and for the behaviors and adherence scales from *never* to *always.* The development and validation of the instrument of the PAPA instrument is reported elsewhere (Alumran, Hou, & Hurst, 2013a, 2013b; Alumran, et al., 2014).

For each scale in the PAPA instrument, the score is calculated by using the loadings given in Alumran, et al. (2014). A higher score on any scale is generally desirable. For example: a higher score on the *Behaviour* means better behaviour regarding appropriate use of antibiotics.

The outcome variable in the study is the number of antibiotic courses used in the youngest children in the family during the last year. Covariates in the study include: (1) the parent-related psychosocial scores measured in the instrument: knowledge and beliefs, behaviours, adherence, seeking information, and awareness

about antibiotics resistance; (2) demographic variables: gender of parent, number of girls and boys in the family, parents health training, parent's age, parents employment status, parent's education level, parent's geographical background, when the parent moved to the Eastern Province, and parent's monthly income; and (3) child's health-history information, including: number of cold episodes for the youngest child during the last year, and whether any of the children in the family has ever had a serious infectious disease or a chronic disease.

Procedure:

In this study a previously developed (Alumran, et al., 2013b) and validated instrument was used in a cross-sectional study design (Alumran, et al., 2013a) (Alumran, et al., 2014). Ethical clearances were obtained from the Department of Development and Planning in the Ministry of Education in the Eastern Province in Saudi Arabia (Ethical approval number: 33505889) and Queensland University of Technology (Ethical approval number: 1200000022).

Statistical analysis:

All data analysis was conducted use stata SE/v1 (Stata, 2011) and Statistical Package for Social Sciences (SPSS v19) (IBM, 2010). Ordinal logistic regression was performed to obtain both crude and adjusted odds ratios, where the study effects are the psychosocial scales in the instrument, i.e. knowledge and beliefs, behaviors, adherence, seeking information, and awareness about antibiotics resistance. Multivariable model building was conducted using Purposeful Selection of Covariates (PSC) (Hosmer, Lemeshow, & May, 2008). Purposeful selection of covariates allows for detection and adjustment for confounders. All model standard

errors were adjusted for the schools clustering effect. Model adequacy was assessed by using Likelihood Ratio Tests and the pseudo R^2.

The first step of the PSC process is to obtain crude estimates of all individual risk factors, then all effects whose crude odds ratios revealed a $p<0.25$ were included in an initial multivariable ordinal logistic regression model along with the study effects (i.e. the PAPA scales which were forced into all subsequent models). Then, the model is rerun excluding all covariates with $p>0.05$, except the PAPA scales which are retained regardless. After that, one at a time, the excluded covariates are going to be re-entered in the model to determine if: 1) they become significant ($p<0.05$), or 2) they represent confounders of the study effects (i.e. alter the coefficients of the PAPA scales by 20% or more). Then, one at a time, the excluded covariates from the initial model (i.e. $p > 0.25$) are going to be re-entered in the model to check if they become significant or potential confounders. Finally, the model adequacy is evaluated using the overall model significance and the pseudo R^2. All individual effect standard errors are adjusted for the school clustering effect.

RESULTS

Parents' baseline characteristics are shown in **Table 9.1**. Half of the participants are mothers (52%). The average age of parents in the study was 38 years old (SD= 8), ranging between 19 and 72 years. 10% of the parents are trained in health fields such as medical, nursing, and/or paramedical fields. More than half of the parents in the study are employed (57%). Most participants have Diploma or Bachelor degrees (63%), and only 1% are illiterate. The average reported monthly income in the study sample is from 4000 to 11,999 SR representing 33% of the sample, followed by 12,000 to 21,999 SR (32%).

From the parents in the study, 39 (3.5%) reported having at least one child

who have experienced a serious infectious disease in the past, these infectious diseases include: chicken pox, flu including swine flu, and mumps and measles. 141 (12.8%) of parents reported having a child with a chronic disease, such as: asthma, eczema, blood disorders such as Thalassemia and Anemia (including Hemolytic anemia and Sickle cell anemia), allergies (including skin allergies), diabetes, Glucose-6-phosphate dehydrogenase (G6PD) deficiency, and heart diseases including arrhythmia.

Means and standard deviations of the psychosocial scales in the instruments along with Spearman's correlation coefficient of each scale with the number of antibiotics courses is given in **Table 9.2**. In addition, Overall, 43.9% of the parents in the study used an antibiotic 2 to 3 times during the last year for the youngest child in the family, followed by once a year (26.8%), 12.4% of the parents indicated that they never used an antibiotic for their youngest child in the past year, and 11.7% reported the use of antibiotics for their youngest child four to five times a year, and only 5% reported to have used an antibiotic more than 6 times a year for their youngest child. **Table 9.3** shows the relationship between the number of antibiotics used for the youngest child in the family during last year and the number of cold episodes for the same child in the same period.

Table 9.1 – Parents baseline characteristics

Variable	Amount of antibiotics (times/Year)					Total
	Never	Once	2 – 3	4 – 5	> 6	
Parent						
Mother	5.4	13.5	23.3	6.5	3.2	52.0
Father	7.0	13.3	20.6	5.3	1.7	48.0
Health Trained						
Yes	2.0	2.8	4.4	1.1	0.3	10.6
No	10.4	24.1	39.5	10.8	4.7	89.4
Employment						
Employed	6.7	15.5	26.3	6.7	2.4	57.6
Unemployed	0.3	0.3	1.0	0.3	0.1	1.9
Student	0.3	0.3	0.3	0.0	0.0	0.8
Housewife	3.1	7.5	11.9	3.8	2.0	28.3
Private Business	1.3	2.5	3.0	0.8	0.5	8.1
Retired	0.7	0.8	1.4	0.3	0.0	3.2
Education						
Illiterate	0.1	0.2	0.5	0.1	0.1	0.9
No Formal Certificate	0.3	0.6	1.0	0.6	0.2	2.6
Intermediate School	0.5	1.1	2.1	0.6	0.5	4.7
High School	1.7	5.0	9.3	2.2	1.4	19.5
Diploma or Bachelor	8.0	17.5	26.9	7.8	2.7	62.9
Higher Degree	1.9	2.5	4.2	0.6	0.2	9.4
Geographical Background						
Eastern Province	5.6	12.3	19.4	5.1	2.0	44.4
Western Province	1.2	2.8	2.6	0.8	0.2	7.6
Central Province	1.9	4.4	5.8	2.2	0.6	14.9
Northern Province	0.6	0.6	1.9	0.6	0.0	3.6
Southern Province	1.8	3.9	8.4	1.9	0.9	16.9
Non-Saudi	1.4	3.0	5.6	1.3	1.3	12.5
Move to Eastern Province						
Childhood	1.5	5.5	9.6	2.1	0.9	19.7
Adolescent	0.7	2.1	1.5	0.4	0.1	4.7
Adulthood	4.7	8.3	13.0	4.1	1.7	31.8
NA[a]	5.5	12.0	19.2	5.0	2.1	43.8
Monthly income						
Low	0.9	2.1	4.8	1.7	0.7	10.1
Medium-low	4.1	8.0	16.3	4.5	2.1	35.1
Medium	4.1	9.6	14.1	4.3	1.3	33.4
Medium-high	2.5	5.8	5.5	1.1	0.8	15.8
High	1.0	1.3	3.2	0.2	0.0	5.6

[a]NA: originally from the Eastern Province

Table 9.2 – Summary statistics of the psychosocial scales and spearman's coefficient of each scale with the number of antibiotics use.

	Mean	Median	SD	Range	Spearman's rho
KB	23.5	23.6	6.1	32.448	-0.3010**
B	19.6	20.9	3.7	18.34	-0.1189**
AD	29.9	30.8	7.4	32.352	-0.1413**
SI	27.4	28.4	8.7	40.532	0.0180
ABR	13.8	14	2.6	15.256	-0.0429

**p<0.001

Table 9.3 – Cross tabulation of the frequency of antibiotics use and common cold episodes for the youngest child in the past year

		Antibiotic Use (times/year)					
		Never	**Once**	**2 - 3**	**4 - 6**	**> 6**	**Total**
Cold Episodes (times/year)	**Never**	46	7	8	0	0	**61**
	Once	47	156	43	8	3	**257**
	2 - 3	38	122	364	44	7	**575**
	4 - 6	2	6	54	64	13	**139**
	> 6	0	1	5	12	30	**48**
	Total	**133**	**292**	**474**	**128**	**53**	**1080**

$\chi^2(16) = 1.04e^3$ P < 0.001

The results from the χ^2 test of independence (**Table 9.3**) reveal a significant association between the number of cold episodes and the frequency of antibiotics used. After conducting the bivariate analysis, the frequency of antibiotics used for the youngest child in the family in the last year was analysed against a set of covariates, including: demographic variables and child health-related history, and parents-related psychosocial factors and antibiotic use. The crude odds ratios resulting from this analysis are given in **Table 9.4**.

To obtain adjusted estimates, purposeful selection of covariates was used to develop the best ordinal logistic regression model for the outcome at hand, the model is adjusted for cluster of schools. Odds ratios are used to present the results of the ordinal logistic regression **(Table 9.4)**. Likelihood Ratio Chi-square is used to report the overall model significance. The model was significant (LR $\chi^2(32) = 693.84$, $p < 0.0001$, Pseudo R2 = 0.2686) with 11 variables **(Table 9.4)**. Global test was performed for multi-category predictors using Likelihood Ratio before considering the significance of their individual contrasts.

The ordinal logistic regression (**Table 9.4**) revealed that knowledge and beliefs, behaviours, and seeking information were negatively associated with antibiotic use in their children (OR_{KB}: 0.92, $p<0.0001$, 95%CI: 0.89, 0.94; OR_{B}: 0.95, $p<0.05$, 95%CI: 0.92, 0.99; OR_{SI}: 0.98, $p<0.01$, 95%CI: 0.96, 0.99). For all three of these scales, a unit increase was associated with an 8%, 5%, and 2% decrease in their odds of being in the next highest antibiotic use category.

Table 9.4 – Determinants of Antibiotic Use in Children by their Parents

LR $\chi^2(32) = 693.84$, $p < 0.0001$, Pseudo R2 = 0.2686

Effect	OR_{crude} [a]	$OR_{adjusted}$	95%CI [c]	
Knowledge and beliefs	**0.905*** **	0.918***	0.897	0.941
Behaviors	**0.937*** **	0.952*	0.915	0.991
Adherence	**0.963*** **	0.992	0.973	1.013
Seeking information	1.004	0.976**	0.961	0.991
Awareness about antibiotics resistance	**0.968**	1.048	0.995	1.105
Fathers	**0.752**			
Number of Girls	1.034			
Number of Boys	1.018			
Parent not health trained	**1.431**			
Age	**0.983***	1.011	0.990	1.032
Employment	χ^2_{LR}= 98.01***	χ^2_{LR}= 7.59		
Employed	**1**	1		
Unemployed	**1.311**	1.191	0.458	3.096
Student	**0.281***	0.298	0.059	1.506
Housewife	**1.145**	0.762	0.535	1.085
Private business	**0.782**	0.666	0.409	1.083
Retired	**0.576**	0.559	0.246	1.270
Education	χ^2_{LR}= 98.74***	χ^2_{LR}=7.76		
Illiterate	**1**	1		
No formal certificate	**1.112**	0.973	0.191	4.966
Intermediate School	**0.955**	0.777	0.168	3.597
High school	**0.876**	0.990	0.233	4.215
Diploma or Bachelor	**0.678**	0.629	0.147	2.688
Higher Degree	**0.457***	0.473	0.103	2.168
Geographical background	χ^2_{LR}= 95.03***	χ^2_{LR}= 3.56		
Eastern Province	**1**	1	1	
Western Province	**0.679**	0.567*	0.340	0.945
Central province	**1.004**	1.011	0.688	1.484
Northern province	**1.168**	0.986	0.479	2.026
Southern province	**1.228**	1.018	0.702	1.477
Non-Saudi	**1.334**	1.169	0.740	1.846
Move to Eastern Province	χ^2_{LR}= 85.90***			
Childhood	1			
Adolescent	0.640			
Adulthood	0.846			
NA [b]	0.863			
Monthly income	χ^2_{LR}= 104.87***	χ^2_{LR}= 2.96		

Low	**1**	1		
Medium-low	**0.765**	0.781	0.467	1.306
Medium	**0.621***	0.740	0.427	1.280
Medium High	**0.410*****	0.615	0.332	1.139
High	**0.456****	0.862	0.396	1.877
Cold Episodes/year	χ^2_{LR}= 739.31***	χ^2_{LR}= 637.42***		
Never	**1**	1		
Once a year	**8.642*****	10.313***	5.028	21.155
2 – 3 times/yr	**54.480*****	70.499***	33.875	146.717
4 – 6 times/yr	**526.762*****	766.572***	329.001	1786.113
> 6 times/yr	**5850.312*****	6233.587***	2179.287	17830.42
No serious infec. Dis.	0.820			
No chronic disease	**0.506****			

*p<0.05, **p<0.01, ***p<0.001

[a] Crude odds rations in bold were there with p<0.25

[b] originally from the Eastern Province

[c] Using robust estimates of standard errors

The most profound effect in the model was the number of cold episodes in the previous year. As the frequency of children's cold events increase, there was a large increase in the odds of increased antibiotic use (χ^2_{LRT} = 637.42, df= 4, p <0.001). Relative to children who had no cold events, parents had 10.313 times the odds of going up to the next higher antibiotic use category (OR_{colds2}=10.31, p<0.0001, 95%CI: 5.02, 21.15). For children who had greater than 6 cold episodes in the previous year, the odds of a category increase in antibiotic use 6233.587 times that of parents whose child has no cold episodes (OR= 6233.59, p<0.0001, 95%CI: 2179.28, 17830.42).

It is noteworthy that a number of demographic risk factors identified as highly significant at the bivariate level (Parental age, employment, education, geographical background, when they moved to the eastern province, and monthly income), these covariates were not significant (or dropped out as non significant) in the final model. However, a number of these factors were still retained in the model as confounders.

The parent's original geographical background was significantly associated with the number of antibiotics used. The odds of using antibiotics one level higher decrease by 43% in those originally from the Western Province compared to the Eastern Province (OR_{geo2}= 0.57; p<0.05; CI: 0.34, 0.95).

Several covariates influence the number of antibiotics used for the youngest child in the family during the last year. These covariates are not significantly associated with the outcome variable; however, they are considered as potential confounders. These confounders include: parent's age, parent's education level, parent's employment status, and parent's monthly income. These predictors confound the parent's geographical background, and all were either potentially

important or significant at the crude level of analysis but were no longer significant after adjusting for the rest of the covariates in the model.

DISCUSSION

A number of factors were identified as potentially important at the bivariate level, but after adjusting for other covariates they could not be identified as significant predictors of antibiotic use. For instance, parent's gender, health-related training, and whether any of the children has a chronic disease were significantly associated at the crude level with parental use of antibiotics, but were no longer significant after adjusting for other covariates. Other variables were significant or potentially important at the crude level of association, such as: parent's monthly income, parent's level of education, parent's age, and parent's employment status, these variables were no longer significant after adjusting for the rest of the covariates but were confounders on the parental use of antibiotics in children. Furthermore, parent's age, parent's education level, parent's employment status, and parent's monthly income are considered confounders on the parental use of antibiotics.

Perhaps, the most important finding in the present study is the high positive association between the number of cold episodes occurring, and the number of antibiotics used, for the youngest child in the family in the last year. While difficulties in measurement meant that cold events could not be directly linked with antibiotic events, we feel that this association provides a strong indication of use of antibiotics in Saudi Arabia to treat cold episodes in children; a misuse of antibiotics to treat viral infections. It is important to note that this association is considered significant after adjusting for the parental psychosocial aspects, which means that this strong positive association between cold episodes and antibiotic use in Saudi

Arabia is not in any way confounded by parent-related psychosocial aspects such as: their knowledge and beliefs, their behaviours and so on, and it is a pure association between cold infections and antibiotics usage.

It is also important to note that parent's originally from the Western Province appear to have lower prevalence of antibiotic usage compared to the Eastern Province which in turn does not differ from other provinces and non-Saudis in the study. This may be because of social determinants such as the diversity of cultures in the Western Province.

The problem of using antibiotics to treat common colds is apparent in many countries around the world. A study in Vietnam revealed that most children with common colds had been given antibiotics, where 71% of mild Acute Respiratory Infections were inappropriately treated with antibiotics (Nguyen, et al., 2011). A study in Saudi Arabia showed that antibiotics were dispensed without a medical prescription for 75% cases of UTIs in a Saudi study (Bin Abdulhak, et al., 2011). 54.5% of children younger than 5 years old with cough were prescribed antibiotics in a study conducted in The Gambia (Risk, et al., 2013). In Panagakou et al. (2011), when parents were asked for possible treatment options for URTIs, 74% of the time antibiotics were chosen as a possible therapy. This unjustified use of antibiotics for treating viral infections needs to be addressed and policy makers need to develop intervention strategies targeted to reduce this problem.

The overuse or unjustified use of antibiotics is one of the primary causes in the development of antibacterial resistance worldwide and many studies discuss the overuse of antibiotics as one of the most important aspects in the development of antibacterial resistance (Centers for Disease Control and Prevention, 2009; Levy & Marshall, 2004). A study conducted in Nepal, found that the total community use of antibiotics influences more on the development of antibacterial resistance than the

individual use (Walson, Marshall, Pokhrel, Kafle, & Levy, 2001). Discovering the factors influencing this overuse leads to formulation of policies and implementation of strict regulations that might help in the reduction of the antibacterial resistance, and therefore decreasing the burden of diseases around the world.

The current study showed that with the increase in parents' knowledge and beliefs (i.e. better knowledge and beliefs about appropriate antibiotic use), and their behaviour (i.e. better judicious behaviour) regarding antibiotic use, their use of antibiotics decreases. Several studies have assessed patients'/parents' knowledge and beliefs regarding the use of antibiotics. Similar to the currents study, Larson et al. (2006) found that almost half of the participants in the study believed that antibiotics cure all types of infections including viral, and fungal infections. In the present study, almost half of the parents believed that antibiotics cure common colds in children; a results consistent with other studies (Belongia, et al., 2002; Cho, Hongb, & Parkc, 2004). These findings suggest that patients and/or parents around the world lack the appropriate knowledge and beliefs about antibiotic use. Therefore, it is important to develop strategies that increase the public's knowledge and beliefs about the appropriate use of antibiotics, especially in children, or impose (where absent) or implement (where present) strict regulations about antibiotics prescriptions and dispensing.

The influence of Adherence to appropriate antibiotic doses on the parental use of antibiotics is needed by the parent's education level and monthly income, this is consistent with the results from (Chapter 8 in this thesis) which showed that Education was a confounder in the model and parent's monthly income was significantly associated with Adherence. This result is consistent with several studies suggest that adherence to medication is largely explained by someone's socio-economic status (Brown & Bussell, 2011; Glombiewski, Nestoriuc, Rief, Glaesmer,

& Braehler, 2012; Touchette & Shapiro, 2008; Wamala, Merlo, Bostrom, Hogstedt, & Agren, 2007). However, this study adjusted for monthly income and education levels, so Adherence levels in relation to the parental use of antibiotics is purely after adjusting for these socioeconomic effects.

It is important to note that in this study there is no direct link between cold events and antibiotics events, which is considered a limitation. However, this limitation is inevitable, since obtaining these associations requires clinical tests that were not within the scope of this study.

CONCLUSION:

The factors influencing the parental use of antibiotics in children in Saudi Arabia are assessed in this study. Several variables were significantly associated with the frequency of antibiotics use, these include: (1) parents psycho-social factors, including: parents' knowledge and beliefs about appropriate antibiotics use, appropriate parental behaviors regarding the use of antibiotics, and parental eagerness to seek health-related information, the higher the parent's score in these scales the less they used antibiotics; (2) demographic characteristics, including: parent's geographical background, where parents from the Western Province use antibiotics significantly less than parents from the Eastern Province in Saudi Arabia; and (3) child's health-related history, including: the number of cold episodes occurring for the youngest child in the past year. Where with the increase of cold episodes in the child, the frequency of antibiotics used increases.

This is the first population-based study in Saudi Arabia that measures the factors influencing the parental use of antibiotics, including psychosocial factors. The study revealed a strong association between the number of cold incidence and

the prevalence of antibiotics used, suggesting misuse and overuse of antibiotics in Saudi Arabia.

The study is also the first to assess the prevalence of antibiotic use in relation to antibiotic-specific psychosocial factors. Parent's knowledge and beliefs about the appropriate use of antibiotics, parent's appropriate behaviours regarding antibiotic use, and parent's eagerness to seek health-related information were all shown to be significantly associated with the parental use of antibiotics.

This study provides evidence for future intervention strategies targeted at reducing the use of antibiotics in Saudi Arabia, by: strengthening antibiotic dispensing regulations, advocating parents' judicious use of antibiotic, and raise the community's awareness about the potential dangers in the misuse of antibiotics. This in turn should help in reducing the levels of antibacterial resistance in the community. Which will lead to a reduction in the burden of health care in Saudi Arabia and the cost of health services.

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The following is the format for the required declaration provided at the start of any thesis chapter which includes a co-authored publication.

The authors listed below have certified* that:

1. they meet the criteria for authorship in that they have participated in the conception, execution, or interpretation, of at least that part of the publication in their field of expertise;
2. they take public responsibility for their part of the publication, except for the responsible author who accepts overall responsibility for the publication;
3. there are no other authors of the publication according to these criteria;
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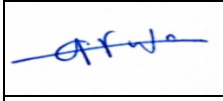
Contributor	Statement of contribution*
Arwa Alumran  30/10/2013	Designed the study and directed its implementation, including data collection, analysis and interpretation, as well as critical discussion of the findings, and drafted the manuscript
Xiang-Yu Hou	Assisted in drafting the manuscript by reviewing it and revising it critically for important intellectual content
Jiandong Sun	Assisted in drafting the manuscript by reviewing it and revising it critically for important intellectual content
Abdullah Yousef	Assisted in data acquisition and drafting the manuscript by reviewing it and revising it critically for important intellectual content
Cameron Hurst	Helped in the design and conduction of the study and its analysis, and helped in drafting the article by reviewing it and revising it critically for important intellectual content

Principal Supervisor Confirmation

I have sighted email or other correspondence from all Co-authors confirming their certifying authorship.

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Name	Signature	Date

Chapter 10: Discussion and Conclusion

This chapter summarizes the results from the five original manuscripts at a comprehensive level including substantive discussion, recommendations for reducing the use of antibiotics in Saudi Arabia, recommendations for future research, limitations of this study, and conclusions.

The studies included 2 main results: (1) the PAPA instrument, and (2) the variables influencing the parents' use of antibiotics in children in Saudi Arabia. All results are available in consecutive manuscripts either published or submitted for publication.

10.1 SUMMARY OF RESULTS

This study aimed to provide baseline epidemiological data on the use of antibiotics in children in KSA, by discovering the factors influencing the use of antibiotics in children by their parents in KSA. This could only be achieved using a valid and reliable measurement instrument to assess these factors. And since there was no available valid and reliable measurement instrument directed to measure the aspects we intended to measure in the literature (Alumran, Hou, & Hurst, 2012), we developed the Parental Perceptions on Antibiotics (PAPA) instrument; which measures the factors influencing the use of antibiotics in children. Only then we could utilize the developed framework to identify the factors associated with the parental use of antibiotics in children in the Saudi context. And therefore, make recommendations for implementation of intervention strategies and evidence-based policy solutions.

10.1.1 Development of the Parental Perception on Antibiotics (PAPA) Scales:

A content evaluation panel was the approach used in this study to build the group brainstorming process. The study was conducted using the Delphi technique, which is an iterative process, seeking consensus from a group of panel member or content experts through multiple rounds of questionnaires.

After obtaining ethical approvals from University of Dammam, Saudi Arabia and Queensland University of Technology, Australia, Panellists were approached via email. Each panel member was independent, and anonymity of panel members was ensured.

Questions included in the first round of the study were obtained from relevant literature. Experts were asked to rate, comment, and add/suggest new questions. At the final round of the study, consensus was reached within all panel members to 58 items (including demographics), thus, achieving content validation of the instrument. The instrument was then translated to Arabic by adapting Brislin's method of translation (Brislin, 1986), which includes forward and backward translation [**Details of this study are available in Chapter 5 (Alumran, et al., 2012)*].

The instrument is considered content valid after achieving consensus within the panel members in the Delphi study (Alumran, Hou, & Hurst, 2013b) [**Details about instrument's content validity are available in* ***Chapter 5***]. Face validity was confirmed after conducting the pilot study (Alumran, Hou, & Hurst, 2013a), where the instrument clarity and un-ambiguity (including: grammar, syntax, organization, appropriateness, logical flow) was assessed and confirmed [**Details about instrument's face validity are available in* ***Chapter 6***].

Instrument's construct validity was assessed in two stages of factor analysis.

(1) *Exploratory factor analysis* was conducted to determine the number and nature of the underlying constructs in the instrument. 238 parents of children younger than 12 years old were recruited from primary schools in the Eastern Province of Saudi Arabia from March to April 2012 (Alumran, et al., 2013a). Six factors were produced using Parallel analysis based on Principal Components Analysis. Scree plots and Kaiser Criteria (Eigen value > 1) were used along a theoretical basis for choosing the number of factors. Then, Principal axis factoring was used to determine the nature of the underlying factors. The internal consistency of the instrument was measured using Cronbach's alpha (Cronbach's alpha= 0.78). (2) *Confirmatory factor analysis* was conducted using 1104 parents of children younger than 12 years old attending primary schools parental meetings in the Eastern Province of Saudi Arabia from September 2012 to January 2013 (Alumran, Hou, Sun, Yousef, & Hurst, 2014). A five-factor model was confirmed with the model showing good fit [GFI= 0.915, RMSEA= 0.047, The raw χ^2= 1470.334, and χ^2/df= 3.484 with p-value < 0.0001]. Constructs in the model include: *Knowledge and Beliefs, Behaviors, Sources of information, Adherence,* and *Awareness about antibiotics resistance*. The instrument was shown to have good internal consistency. All items in the model loaded significantly at the 0.001 level of significance on their respective factors with standardized betas ranging from 0.19 to 0.83.

After performing Factor analysis, construct validity of the instrument was achieved [**Details about instrument's construct validity are available in **Chapters 6 and 7***, (Alumran, et al., 2013a) ***and*** (Alumran, et al., 2014), ***The items in the instrument are available in **Chapter 4***]. The Average Variance Extracted (AVE) of the constructs in the study were measured and compared to the inter-factor correlations (Gefen, Straub, & Boudreau, 2000). Convergent validity was

determined when the AVE of each construct was higher than its correlation with other constructs. Convergent validity of the instrument was confirmed. Discriminant validity of the PAPA scales was determined by assessing the Maximum Shared Variance (MSV) and the Average Shared Squared Variance (ASV), both were found to be lower than the Average Variance Extracted (AVE) for all of the constructs in the scale (Hair, Black, Babin, & Anderson, 2010). Discriminant validity of the instrument was confirmed **[****Details about instrument's Convergent and Discriminant validity are available in* ***Chapter 7*** (Alumran, et al., 2014).

10.1.2 Variables influencing psychosocial factors underlying antibiotic use

Modeling of the PAPA scales:

The psychosocial scales in the instrument were tested against all of the rest of the covariates in the instrument, including: Demographical variables related to parent's: gender, number of girls and boys in the family, whether the parent is health trained, age, employment, education, geographical background, when they moved to the Eastern province (i.e., childhood, adolescents, adulthood), monthly income; and Child health-related history: number of cold episodes occurring in the youngest child during the last year, whether any of the children in the family had had a serious infectious disease in the past, or has a chronic disease.

1104 parents were included in the study; these parents were approached in primary schools parental meetings in the Eastern Province of Saudi Arabia from September 2012 to January 2013. The PAPA instrument was used to collect data necessary for this study. General linear models were used to produce 5 statistical models (**Table 10.1)**; detailed information (i.e. coefficients and confidence intervals) about these models is available in **Table 10.2.**

Table 10.1 - Psychosocial models in the study

Outcome	Variables in the model
Knowledge and beliefs (KB)	Gender, health training, age, education, move to eastern province, monthly income, cold episodes, and chronic disease.
Behaviors (B)	Gender, age, employment, geographical background, move to eastern province, and monthly income.
Adherence (AD)	Gender, number of boys, health trained, age, education, geographical background, move to eastern province, and monthly income
Seeking information (SI)	Gender, number of boys, number of girls, age, move to eastern province, monthly income, cold episodes, and infectious diseases.
Awareness about antibiotic resistance (ABR)	Gender, health trained, employment, geographical background, move to eastern province, and monthly income.

BIBLIOGRAPHY

Ahmed, K., & Al-Saadi, A. (2005). A survey of multiple prescriptions dispensed in Saudi Arabia. *Pak J Pharm Sci, 18*(2), 1-2.

Akici, A., Kalaca, S., Ugurlu, U., & Oktay, S. (2004). Prescribing habits of general practitioners in the treatment of childhood respiratory-tract infections. *Eur J Clin Pharmacol, 60*(1), 211-216.

Al-Azzam, S., Al-Husein, B., Alzoubi, F., Masadeh, M., & Al-Horani, M. (2007). Self-Medication with Antibiotics in Jordanian Population. *IJOMEH, 20*(4), 373-380.

Al-Bakri, A., Bustanji, Y., & Al-Motassem, Y. (2005). Community consumption of antibacterial drugs within the Jordanian population: sources, patterns and appropriateness. *Int J Antimicrob Agents, 26*(5), 389 - 395.

Al-Faris, E., & Al-Taweel, A. (1999). Audit of prescribing patterns in Saudi primary health care: What lessons can be learned? *Ann Saudi Med, 19*(4), 317-321.

Al-Hassan, M. I. (2011). Community pharmacy practice in Saudi Arabia: An overview. *The Internet Journal of Pharmacology, 9*(1). Retrieved September 2013, from http://archive.ispub.com/journal/the-internet-journal-of-pharmacology/volume-9-number-1/community-pharmacy-practice-in-saudi-arabia-an-overview.html#sthash.6hv727u0.dpuf

Alshara, M. (2011). Antimicrobial Resistant Pattern of Escherichia coli Strains Isolated from Pediatric Patients in Jordan. *Acta Medica Iranica, 49*(5), 293-295.

Alumran, A., Hou, X.-Y., & Hurst, C. (2012). Validity and reliability of instruments designed to measure factors influencing the overuse of antibiotics. *J Infect Public Health, 5*(3), 221-232.

Alumran, A., Hou, X.-Y., & Hurst, C. (2013a). Assessing the overuse of antibiotics in children in Saudi Arabia: Validation of the parental perception on antibiotics scale (PAPA scale). *Health Qual Life Outcomes, 11*(1), 39.

Alumran, A., Hou, X.-Y., & Hurst, C. (2013b). Assessing the overuse of antibiotics in children with URTIs in Saudi Arabia: Development of the parental perception on antibiotics scale (PAPA scale). *J Epidemiol Glob Health, 3*(1), 3-10.

Alumran, A., Hurst, C., & Hou, X.-Y. (2011). Antibiotics overuse in children with upper respiratory tract infections in Saudi Arabia: Risk factors and potential interventions. *Clinical Medicine and Diagnostics, 1*(1), 8-16.

Arbuckle, J. L. (2006). Amos (Version (Version 7.0)). Chicago: SPSS.

Aronson, J. K. (2007). Compliance, concordance, adherence. *Br J Clin Pharmacol, 63*(4), 383–384.

Arroll, B., & Kenealy, T. (2005). Antibiotics for the common cold and acute purulent rhinitis (Review). *Cochrane Database of Systematic Reviews*(3)

Austin, D., Kristinsson, K., & Anderson, R. (1999). The relationship between the volume of antimicrobial consumption in human communities and the frequency of resistance. *Proc Natl Acad Sci USA, 96*(3), 1152 - 1156.

Awad, A., Eltayeb, I., Matowe, L., & Thalib, L. (2005). Self-medication with antibiotics and antimalarials in the community of Khartoum State, Sudan. *J Pharm Pharmaceut Sci, 8*(2), 326-331.

Bawazir, S. (1992). Prescribing pattern at Community Pharmacies in Saudi Arabia. *International Pharmacy Journal, 6*(5), 222-224.

Belongia, E., Naimi, T., Gale, C., & Besser, R. (2002). Antibiotic use and upper respiratory infections: A survey of knowledge, attitudes, and experience in Wisconsin and Minnesota. *Prev Med, 34*(3), 346-352.

Bhasin, S., Budden, E., Ketkar, A., & Pawar, A. (2002). Current trends in the treatment of upper respiratory tract infections in neonates, infants and children: A survey. *Indian J Pharmacol, 34*(1), 62-63.

Bi, P., Tong, S., & Partonc, K. (2000). Family self-medication and antibiotics abuse for children and juveniles in a Chinese city. *Social Science & Medicine, 50*(10), 1445-1450.

Bin Abdulhak, A., Al Tannir, M., Almansor, M., Almohaya, M., Onazi, A., Marei, M., et al. (2011). Non prescribed sale of antibiotics in Riyadh, Saudi Arabia: A Cross Sectional Study. *BMC Public Health, 11*(1), 538-542.

Borg, M., & Scicluna, E. (2002). Over-the-counter acquisition of antibiotics in the Maltese general population. *Int J Antimicrob Agents, 20*(4), 253-257. doi: 10.1016/S0924-8579(02)00194-2

Braun, B., & Fowles, J. (2000). Characteristics and Experiences of Parents and Adults Who Want Antibiotics for Cold Symptoms. *Arch Fam Med, 9*(7), 589-595.

Brislin, R. W. (1986). The wording and translation of research instruments. In W. J. L. J. W. Berry(Eds.) (Ed.), *In Field methods in cross-cultural research* (pp. 137-164). BeverlyHills, CA: Sage.

Brooks, L., Shaw, A., Sharp, D., & Hay, A. D. (2008). Towards a better understanding of patients' perspectives of antibiotic resistance and MRSA: a qualitative study. *Fam Pract, 25*(5), 341-348. doi: 10.1093/fampra/cmn037

Brown, M. T., & Bussell, J. K. (2011). Medication Adherence: WHO Cares?. *Mayo Clin Procv, 86*(4), 304–314. doi: 10.4065/mcp.2010.0575

Browne, M. W., & Cudeck, R. (1993). *Alternative ways of assessing model fit*. Beverly Hills, CA: Sage.

Burge, S., White, D., Bajorek, E., Bazaldua, O., Trevino, J., Albright, T., . . . Cigarroa, L. (2005). Correlates of Medication Knowledge and Adherence: Findings From the Residency Research Network of South Texas. *Fam Med, 37*(10), 712-718.

Butler, C., Kinnersley, P., Prout, H., Rollnick, S., Edwards, A., & Elwyn, G. (2001). Antibiotics and shared decision-making in primary care. *J Antimicrob Chemother, 48*(3), 435-440. doi: 10.1093/jac/48.3.435

Byrne, B. M. (1994). *Structural equation modeling with EQS and EQS/Windows*. Thousand Oaks, CA: Sage Publications.

Cebotarenco, N., & Bush, P. (2008). Reducing antibiotics for colds and flu: a student-taught program. *Health Educ Res, 23*(1), 146-157.

Centers for Disease Control and Prevention (2009). *Antibiotic resistance questions & answers*. Retrieved September 2013, from www.cdc.gov/getsmart/antibiotic-use/antibiotic-resistance-faqs.html#c

Central department of statistics and information (2011). *Key indicators*. Retrieved 25 April 2011, from http://www.cdsi.gov.sa/english/

Chan, G., & Tang, S. (2006). Parental knowledge, attitudes and antibiotic use for acute upper respiratory tract infection in children attending a primary healthcare clinic in Malaysia [Original Article]. *Singapore Med J, 47*(4), 266-270.

Cho, H., Hongb, S., & Parkc, S. (2004). Knowledge and beliefs of primary care physicians, pharmacists, and parents on antibiotic use for the pediatric common cold. *Social Science & Medicine, 58*(1), 623–629.

Cohen, M. L. (1994). Antimicrobial resistance: prognosis for public health. *Trends in Microbiology, 2*(10), 422-425.

Colton, D., & Covert, R. (2007). *Designing and constructing instruments for social research and evaluation*. San Francisco, CA: Jossey-Bass.

Comrey, A. L., & Lee, H. B. (1992). *A First Course in Factor Analysis*. Hillsdale, NJ: Erlbaum.

Corbett, K., Gonzales, R., Leeman-Castillo, B., Flores, E., Maselli, J., Kafadar, K. (2005). Appropriate antibiotic use: Variation in knowledge and awareness by Hispanic ethnicity and language. *Prev Med*, *40*(2), 162-169.

Crossley, J., Eiser, C., & Davies, H. (2005). Children and their parents assessing the doctor–patient interaction: A rating system for doctors' communication skills. *Medical Education, 39*(8), 820-828.

Davey, P., Pagliari, C., & Hayes, A. (2002). The patient's role in the spread and control of bacterial resistance to antibiotics. *Clinical Microbiology and Infection, 8*(2), 43-68.

DeVon, H., Block, M., Moyle-Wright, P., Ernst, D., Hayden, S., Lazzara, D., et al. (2007). A Psychometric toolbox for testing validity and reliability. *Journal of Nursing Scholarship, 39*(2), 155-164.

Duarte, D., & Botelho, C. (2000). Clinical profile in children under five year old with acute respiratory tract infections. *Jornal de Pediatria, 76*(3), 207-212.

El-Gilany, A. (2000). Acute respiratory infections in primary health care centres in northern Saudi Arabia. *Eastern Mediterranean Health Journal, 6*(5), 955-960.

Emanuele, P. (2010). Antibiotic resistance. *AAOHN Journal, 58*(9), 363-365. from ProQuest Central database.

Fahey, T., Stocks, N., & Thomas, T. (1998). Systematic review of the treatment of upper respiratory tract infection. *Arch Dis Child, 79*, 225-230.

Farber, J., Ross, J., & Stephens, G. (1954). Antibiotic Anaphylaxis. *81*(1)

Flora, K., Scott, W., Jason, B., & Jonathan, Z. (2008). Improving antibiotic utilization among hospitalists: A pilot academic detailing project with a public health approach. *Journal of Hospital Medicine, 3*(1), 64-70.

Gefen, D., Straub, D., & Boudreau, M.-C. (2000). Structural Equation Modeling and Regression: Guidelines for Research Practice (Vol. 4): Communications of the AIS.

Glombiewski, J., Nestoriuc, Y., Rief, W., Glaesmer, H., & Braehler, E. (2012). Medication Adherence in the General Population. *PLoS ONE, 7*(12), e50537.

Goff, S., Mazor, K., Meterko, V., Dodd, K., & Sabin, J. (2008). Patients' Beliefs and Preferences Regarding Doctors' Medication Recommendations. *J Gen Intern Med, 23*(3), 236–241.

Gonzales, R., Steiner, J., Lum, A., & Barrett, P. (1999). Decreasing Antibiotic Use in Ambulatory Practice: Impact of a Multidimensional Intervention on the Treatment of Uncomplicated Acute Bronchitis in Adults. *JAMA, 281*(16), 1512-1519.

Green, R. (2006). Symptomatic treatment of upper respiratory tract symptoms in children. *SA Fam Pract, 48*(4), 14-19.

Green, S. (1991). How many subjects does it take to do a regression analysis?. *Multivariate Behav Res, 26*(3), 499-510.

Grigoryan, L., Burgerhof, J., Haaijer-Ruskamp, F., Degener, J., Deschepper, R., Monnet, D., et al. (2007). Is self-medication with antibiotics in Europe driven by prescribed use? *J Antimicrob Chemother, 59*(1), 152-156.

Hair, J., Black, W., Babin, B., & Anderson, R. (2010). *Multivariate data analysis* (7th ed.). Upper Saddle River, NJ, USA: Prentice-Hall, Inc.

Harman, H. (1976). *Modern Factor Analysis* (3rd ed.). Chicago, IL: University of Chicago Press.

Health statistical year book (2011). Riaydh, Saudi Arabia: Ministry of Health.

Helms, M., Vastrup, P., Gerner-Smidt, P., & Mølbak, K. (2002). Excess Mortality Associated with Antimicrobial Drug-Resistant Salmonella Typhimurium. *Emerg Infect Dis, 8*(5), 490-495.

Hoa, N. Q., Larson, M., Chuc, N. T. K., Eriksson, B., Trung, N. V., Stalsby, C. L. (2009). Antibiotics and paediatric acute respiratory infections in rural

Vietnam: Health-care providers, knowledge, practical competence and reported practice. *Tropical Medicine & International Health, 14*(5), 546-555.

Hooper, D., Coughlan, J., & Mullen, M. (2008). Structural Equation Modelling: Guidelines for determining model fit. *The Electronic Journal of Business Research Methods, 6*(1), 53-60.

Hosmer, D., Lemeshow, S., & May, S. (2008). Assessment of Model Adequacy. In *Applied Survival Analysis* (pp. 169-206): John Wiley & Sons, Inc.

Huang, S., Rifas-Shiman, S., Kleinman, K., Kotch, J., Schiff, N., Stille, C., et al. (2007). Parental knowledge about antibiotic use: Results of a cluster-randomized, multicommunity intervention. *Pediatrics, 119*(4), 698-706.

IBM, C. (2010). IBM SPSS Statistics for Windows (Version 19.0). Armonk, NY: IBM Corp.

Irshaid, Y., Al-Homrany, M., Hamdi, A., Adjepon-Yamoah, K., & Mahfouz, A. (2004). A pharmacoepidemiological study of prescription pattern in outpatient clinics in Southwestern Saudi Arabia. *Saudi Med J, 25*(12), 1864-1870.

JETACAR (1999). The use of antibiotics in food-producing animals. Australia: Commonwealth Department of Health and Aged Care.

Kozyrskyj, A., Dahl, M., Chateau, D., Mazowita, G., Klassen, T., Law, B. (2004). Evidence-based prescribing of antibiotics for children: role of socioeconomic status and physician characteristics. *Can Med Assoc J, 171*(2), 139-145.

Kunin, C., Lipton, H., Tupasi, T., Sacks, T., Scheckler, W., Jivani, A., et al. (1987). Social, Behavioral, and Practical Factors Affecting Antibiotic Use Worldwide: Report of Task Force 4. *Reviews of Infectious Diseases, 9*(3), 270-285.

Larson, E., Dilone, J., Garcia, M., & Smolowitz, J. (2006). Factors which influence Latino community members to self-prescribe antibiotics. *Nursing Research, 55*(2), 94-102.

Levy, S., & Marshall, B. (2004). Antibacterial resistance worldwide: causes, challenges and responses. *Nat Med, 10*(12), 122-129.

Little, P., Rumsby, K., Kelly, J., Watson, L., Moore, M., Warner, G., et al. (2005). Information leaflet and antibiotic prescribing strategies for acute lower respiratory tract infection: A randomized controlled trial. *JAMA, 293*(24), 3029-3035.

Little, R. (1988). A test of missing completely at random for multivariate data with missing values. *Journal of American Statistical Association, 83*, 1198-1202.

Mahrad, A. (2010). Urban Planning, Construction and Land Market for the Housing Sector in the KSA. Riyadh, Saudi Arabia.

Mainous, A., Hueston, W., Davis, M., & Pearson, W. (2003). Trends in antimicrobial prescribing for bronchitis and upper respiratory infections among adults and children. *Am J Public Health, 93*(11), 1910-1914.

Mainous, A., Hueston, W., Love, M., Evans, M., & Finger, R. (2000). An evaluation of statewide strategies to reduce antibiotic overuse. *Fam Med, 32*(1), 22-29.

Matuz, M., Benko, R., Doro, P., Hajdu, E., Nagy, G., Nagy, E.,Monnet, D, Soos, G. (2005). Regional variations in community consumption of antibiotics in Hungary, 1996–2003. *Br J clin Pharmacol, 61*(1), 96-100.

McNulty, C., Boyle, P, Nichols, T., Clappison, P., & Davey, P. (2007). Don't wear me out—the public's knowledge of and attitudes to antibiotic use. *J Antimicrob Chemother, 59*(1), 727-738. doi: doi:10.1093/jac/dkl558

Mitsi, G., Jelastopulu, E., Basiaris, H., Skoutelis, A., & Gogos, C. (2005). Patterns of antibiotic use among adults and parents in the community: A questionnaire-based survey in a Greek urban population. *Int J Antimicrob Agents, 25*(5), 439-443.

Moellering, R. (1998). Antibiotic resistance: lessons for the future. *Clin Infect Dis, 27*(1), 135-140.

Mora, Y., Avila-Agtiero, M., Umafia, M., Jimenez, A., Paris, M., Faingezicht, I. (2002). Epidemiologic observations of the judicious use of antibiotics in a pediatric teaching hospital. *International Journal of Infectious Diseases, 6*(1), 74-77.

Nguyen, Q., Nguyen, T., Ho, D., Larsson, M., Eriksson, B., & Lundborg, C. (2011). Unnecessary antibiotic use for mild acute respiratory infections during 28-day follow-up of 823 children under five in rural Vietnam. *Transactions of the Royal Society of Tropical Medicine and Hygiene, 105*(11), 628–636. doi: 10.1016/j.trstmh.2011.07.015

Palmer, D., & Bauchner, H. (1997). Parents' and physicians' views on antibiotics. *Pediatrics, 99*(6), 6-10.

Paluck, E., Katzenstein, D., Frankish, J., Herbert, C., Milner, R., Speert, D., & Chambers, K. (2001). Prescribing practices and attitudes toward giving children antibiotics. *Can Fam Physician, 47*(1), 521–527.

Panagakou, S. G., Spyridis, N., Papaevangelou, V., Theodoridou, K. M., Goutziana1, G. P., Theodoridou, M. N., et al. (2011). Antibiotic use for upper respiratory tract infections in children: A cross-sectional survey of knowledge, attitudes, and practices of parents in Greece. *BMC Pediatrics, 11*(60), 60-69.

Peche're, J. (2001). Patients' Interviews and Misuse of Antibiotics. *Clinical Infectious Diseases, 33*(3), 170-173.

Podsakoff, P., MacKenzie, S., & Lee, J.-Y. (2003). Common Method Biases in Behavioral Research: A Critical Review of the Literature and Recommended Remedies. *Journal of Applied Psychology, 88*(5), 879–903.

Ramaker, C., Marinus, J., Stiggelbout, A., & Van Hilten, B. (2002). Systematic evaluation of rating scales for impairment and disability in Parkinson's disease. *Movement Disorders, 17*(5), 867-876.

Risk, R., Naismith, H., Burnett, A., Moore, S. E., Cham, M., & Unger, S. (2013). Rational prescribing in paediatrics in a resource-limited setting. *Archives of Disease in Childhood, 98*(7), 503-509. doi: 10.1136/archdischild-2012-302987

Safran, D., Neuman, P., Schoen, C., Montgomery, J., Li, W., Wilson, I., . . . Rogers, W. (2002). Prescription Drug Coverage And Seniors: How Well Are States Closing The Gap? *Health Aff*, 253-268. doi: 10.1377/hlthaff.w2.253

Sarahroodi, S., Arzi, A., Sawalha, A., & Ashtarinezhad, A. (2010). Antibiotics self-medication among southern Iranian university students. *International Journal of Pharmacology, 6*(1), 48-52.

Sarkar, P., & Gould, I. (2006). Antimicrobial agents are societal drugs: how should this influence prescribing? *Drugs, 66*(7), 893-901.

Saudi Food and Drug Authority (2013). *Saudi Drug Bulletin*. Retrieved 13 June 2013, from

Saudia-online (2013). *Map of Saudi Arabia Shwoing the 13 Provinces*. Retrieved 26/6/2013, from http://www.saudia-online.com/

Simasek, M., & Blandino, D. (2007). Treatment of the common cold. *Am Fam Physician, 75*(4), 515-520.

Simoes, E., Cherian, T., Chow, J., Shahid-Salles, S., Laxminarayan, R., John, T. (2006). *Disease Control Priorities in Developing Countries* (2nd edition ed.). Washington (DC): World Bank.

Skull, S., Ford-Jones, E., Kulin, N., Einarson, T., & Wang, E. (2000). Child care center staff contribute to physician visits and pressure for antibiotic prescription. *Arch Pediatr Adolesc Med, 154*(2), 180-183.

Snow, V., Mottur-Pilson, C., Gonzales, R., Physicians, A. A. o. F., Medicine, A. C. o. P.-A. S. o. I., Control, C. f. D., et al. (2001). Principles of appropriate antibiotic use for treatment of acute bronchitis in adults. *Ann Intern Med, 134*(6), 518 - 520.

Sorkhou, I., Al-Qallaf, B., Hajiah, A., Al-Sheibani, H., Bayoomi, A., Mustafa, A. (2002). Perceptions of patients attending primary care in Kuwait regarding upper respiratory tract infections. *Kuwait med J, 34*(4), 272-275.

Spellberg, B., Guidos, R., & Gilbert, D. (2008). Infectious Diseases Society of America. The epidemic of antibiotic-resistant infections: a call to action for the medical community from the Infectious Diseases Society of America. *Clin Infect Dis, 46*(2), 155-164.

Stallman, H. M., & Hurst, C. P. (2011). The factor structure of the Frost Multidimensional Perfectionism Scale in university students. *Australian Psychologist, 46*(1), 229–236.

Stata, C. (2011). Stata Statistical Software (Version Release 12). College Station, TX: StataCorp LP.

Tabachnick, B., & Fidell, L. (2013). *Using Multivariate Statistics*. New York: Allyn and Bacon.

Teng, C., Leong, K., Aljunid, S., & Cheah, M. (2004). Antibiotic prescription in upper respiratory tract infections. *Asia Pac Fam Med, 3*(1-2), 38-45.

Tenover, F. (2006). Mechanisms of Antimicrobial Resistance in Bacteria. *The American Journal of Medicine, 119*(6), 3–10.

Touchette, D., & Shapiro, N. (2008). Medication Compliance, Adherence, and Persistence: Current Status of Behavioral and Educational Interventions to Improve Outcomes. *JMCP, 14*(6), 2-10.

Unicef (2011). *Statistics*. Retrieved 25 April 2011, from http://www.unicef.org/infobycountry/saudiarabia_statistics.html

Vanden Eng, J., Marcus, R., Hadler, J., Imhoff, B., Vugia, D., Cieslak, P., . . . Besser, R. (2003). Consumer attitudes and use of antibiotics. *Emerg Infect Dis, 9*(9), 1128-1135.

Walson, J., Marshall, B., Pokhrel, B., Kafle, K., & Levy, S. (2001). Carriage of Antibiotic-Resistant Fecal Bacteria in Nepal Reflects Proximity to Kathmandu. *J Infect Dis, 184*(9), 1163-1169.

Wamala, S., Merlo, J., Bostrom, G., Hogstedt, C., & Agren, G. (2007). Socioeconomic disadvantage and primary non-adherence with medication in Sweden. *International Journal for Quality in Health Care, 19*(3), 134-140. doi: 10.1093/intqhc/mzm011

West, J. (2002). Acute upper airway infections: Childhood respiratory infections. *Br Med Bull, 61*(1), 215-230.

World Health Organization (2000). WHO report on infectious diseases 2000. Overcoming antimicrobial resistance. Geneva: WHO/CDS/2000.2.

World Health Organization (2008). Anti-tuberculosis drug resistance in the world, *The WHO/IUATLD Global project on anti-tuberculosis drug resistance surveillance*. Geneva: WHO/HTM/TB/2008.394.

Wutzke, S., Artist, M., Kehoe, L., Fletcher, M., Mackson, J., Weekes, L. (2007). Evaluation of a national programme to reduce inappropriate use of antibiotics for upper respiratory tract infections: effects on consumer awareness, beliefs, attitudes and behaviour in Australia. *Health Promotion International, 22*(1), 53-64.

West, J. (2002). Acute upper airway infections: Childhood respiratory infections. *Br Med Bull, 61*(1), 215-230. doi: 10.1093/bmb/61.1.215

You, J., Yau, B., Choi, K., Chau, C., Huang, Q., & Lee, S. (2008). Public Knowledge, Attitudes and Behavior on Antibiotic Use: A Telephone Survey in Hong Kong. *Infection, 36*(2), 153-157. doi: 10.1007/s15010-007-7214-5

APPENDICES

Appendix A – The Arabic version of the PAPA instrument

عزيزي الوالد / الوالدة

اسمي أروى العمران، طالبة سعودية أدرس الدكتوراه في استراليا، و أهدف في بحثي لدراسة استخدام المضادات الحيوية في المملكة العربية السعودية، فإذا كان في عائلتك طفل أو أكثر بين عمر شهر و 12 سنة فأنت مدعو للمشاركة في هذا البحث.

إذا قررت المشاركة، أرجو منك تعبئة الاستبيان التالي الذي يحوي أسئلة تتعلق بمعلوماتك حول استخدام المضادات الحيوية، و ستستغرق الإجابة على الأسئلة حوالي 15 دقيقة، و **من الضروري الإجابة على كافة الأسئلة**. كما يجب ألا يظهر اسمك في أي مكان في الاستبيان لضمان خصوصيتك و ستظل إجابتك في سرية تامة.

تعبئتك للاستبيان و تقديمك له يعني موافقتك على المشاركة فيه و أنك قرأت التعليمات المذكورة.

أشكرك مقدماً على تعاونك و دعمك لهذا البحث.

تحياتي،

أروى العمران , ماجستير الصحة العامة

معلومات عامة

1. من سيجيب على الاستبيان؟

☐ الأم ☐الأب ☐ أخرى ***الرجاء تحديد** :

- العلاقة أو صلة القرابة بالطفل .....
- الجنس .....

---

2. كم عدد الأطفال في عائلتك (تحت سن 12 سنة) ؟ .....

*الرجاء توضيح أعمار أطفالك (بالسنوات) ، و جنس كل منهم **(باستطاعتك كتابة العمر بالأشهر إذا كان عمر الطفل أقل من سنة)**

الطفل	العمر(بالسنوات)	الجنس
الأول		ذكر / أنثى
الثاني		ذكر / أنثى
الثالث		ذكر / أنثى
الرابع		ذكر / أنثى
الخامس		ذكر / أنثى
المزيد		

3. هل أحد الوالدين مدرّب (او لديه خبرة او معرفة) في أحد المجالات الطبية او التخصاصات الصحية؟

☐ نعم ***الرجاء التحديد** ..... ☐ لا

---

4. كم عمرك (بالسنوات)؟ .....

5. ما هو وضعك الوظيفي؟

☐ موظف ***الرجاء التحديد** ..... ☐غير موظف

☐ طالب ☐ ربة منزل ☐ عمل خاص ☐ متقاعد

---

6. المستوى التعليمي: *(أعلى درجة حصلت عليها)*

☐ لا اقرأ او اكتب ☐ شهادة ابتدائي ☐ شهادة متوسطة

☐ شهادة ثانوية ☐ دبلوم أو جامعي ☐ دراسات عليا (ماجستير، دكتوراه)

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7. ماهي جذورك الجغرافية؟ (ماهي منطقتك الأصلية ؟)

☐ المنطقة الشرقية (الدمام , القطيف ، الأحساء ... الخ)
(إذا حددت هذا الاختيار، فأكمل للسؤال رقم 9)

☐ المنطقة الغربية (جدة، مكة ... الخ)

☐ المنطقة الوسطى (الرياض، القصيم ... الخ)

☐ المنطقة الشمالية (تبوك ، الجوف .. الخ)

☐ المنطقة الجنوبية (أبها ، الباحة ... الخ)

---

8. متى انتقلت للمنطقة الشرقية ؟

☐ في سن الطفولة (12 سنة فأقل)

☐ في سن المراهقة (12-17 سنة)

☐ بعد سن البلوغ (18 سنة فأكثر)

---

9. ماهو دخل العائلة الشهري؟

☐ أقل من 4,000 ريال سعودي شهرياً

☐ 4000 – 11,999 ريال سعودي شهرياً

☐ 12,000 – 21,999 ريال سعودي شهرياً

☐ 22,000 – 34,999 ريال سعودي شهرياً

☐ أكثر من 35,000 ريال سعودي شهرياً

صحة أطفالك

يرجى اكمال هذه الأسئلة حول صحة اصغر طفل لديك

---

1. خلال السنة الماضية، كم مرة تعرض اصغرطفل لديك لنزلة برد؟

☐ لم يتعرض لنزلة برد ☐ مرة بالسنة ☐ 2-3 مرات في السنة

☐ 4-6 مرات في السنة ☐أكثر من 6 مرات في السنة

---

2. خلال السنة الماضية، كم مرة تناول اصغرطفل لديك مضاداً حيوياً؟

☐ لم يتناول مضادا حيويا ☐ مرة بالسنة ☐ 2-3 مرات في السنة

☐ 4-6 مرات في السنة ☐أكثر من 6 مرات في السنة

يرجى اكمال هذه الأسئلة حول أي من اطفالك (أقل من 12 سنة)

---

3. هل تعرض أي من أطفالك (الذين تقل أعمارهم عن 12 سنة) في الماضي الى أحد الأمراض المعدية الخطيرة؟

☐ لا ☐نعم *** الرجاء التحديد** .....

---

4. هل يعاني أي من اطفالك (الذين تقل أعمارهم عن 12 سنة) من مرض مزمن؟

☐ لا ☐نعم *** الرجاء التحديد** .....

الرجاء وضع اشارة [X] عند الاختيار المناسب

المضادات الحيوية والمعلومات الصحية:	لا أوافق بشدة	لا أوافق	محايد	أوافق	أوافق بشدة
1. هناك حاجة لتناول المضادات الحيوية عند التعرض لنزلة برد	☐	☐	☐	☐	☐
2. هناك حاجة لتناول المضادات الحيوية عند التعرض لاحتقان الحلق	☐	☐	☐	☐	☐
3. المضادات الحيوية تعالج الإلتهابات البكتيرية	☐	☐	☐	☐	☐
4. المضادات الحيوية تعالج الإلتهابات الفيروسية	☐	☐	☐	☐	☐
5. يمكن للمضادات الحيوية أن تعالج جميع أنواع الإلتهابات (الفيروسية-البكتيرية-الفطرية)	☐	☐	☐	☐	☐
6. بصفة عامة تعتبر المضادات الحيوية آمنة للاستخدام	☐	☐	☐	☐	☐
7. تساعد المضادات الحيوية في علاج نزلات البرد عند الأطفال	☐	☐	☐	☐	☐
8. قد تضر المضادات الحيوية بصحة الشخص	☐	☐	☐	☐	☐
9. تزيد صعوبة علاج بعض أنواع الجراثيم بالمضادات الحيوية	☐	☐	☐	☐	☐
10. قد يؤدي استخدام المضادات الحيوية بجرعات غير كافية الى ان تصبح الجراثيم اكثر مقاومة للمضاد	☐	☐	☐	☐	☐
11. استمد المعلومات المتعلقة بصحتي من الصيدلاني	☐	☐	☐	☐	☐
12. استمد المعلومات المتعلقة بصحتي من الممرضات أو الممارسين الصحيين	☐	☐	☐	☐	☐
13. أستمد المعلومات التي تتعلق بصحتي من الكتب و والنشرات العلمية	☐	☐	☐	☐	☐
14. أستمد المعلومات التي تتعلق بصحتي من العائلة والأصدقاء	☐	☐	☐	☐	☐
15. أستمد المعلومات التي تتعلق بصحتي من الإنترنت	☐	☐	☐	☐	☐
16. أستمد المعلومات التي تتعلق بصحتي من المواد الإعلامية (الراديو-التلفاز-الصحف)	☐	☐	☐	☐	☐
17. أستمد المعلومات التي تتعلق بصحتي من تجاربي و خبراتي السابقة	☐	☐	☐	☐	☐

الرجاء وضع اشارة [X]عند الاختيار المناسب

معتقداتك ومواقفك الشخصية حول المضادات الحيوية	لا أوافق بشدة	لا أوافق	محايد	أوافق	أوافق بشدة
1. عند تحسن حالة طفلي يمكنني التقليل من جرعة المضاد الحيوي	☐	☐	☐	☐	☐
2. إذا كانت الحالة المرضية لطفلي خفيفة فإني أعطيه الجرعة التي أراها مناسبة لحالته	☐	☐	☐	☐	☐
3. اسقاط (عدم اعطاء) جرعة أو جرعتين من المضاد الحيوي لا يشكل فرق	☐	☐	☐	☐	☐
4. يجب أن تباع المضادات الحيوية بدون وصفة طبية	☐	☐	☐	☐	☐
5. طفلي سوف يعاني من المرض لفترة أطول إذا لم يأخذ مضاد حيوي لعلاج الكحة، و الزكمة، وأعراض البرد	☐	☐	☐	☐	☐
6. إذا أصيب طفلي بنزلة برد أو كحة فمن الأفضل إعطاءه مضاد حيوي للتخلص من المرض	☐	☐	☐	☐	☐
7. أعتقد أن الأطباء يصفون مضادات حيوية بكثرة	☐	☐	☐	☐	☐
8. لا يشرح الأطباء للوالدين حالة طفلهما بشكل كافٍ	☐	☐	☐	☐	☐
9. الأطباء ليس لديهم معلومات جيدة عن الاستعمال السليم للمضادات الحيويه	☐	☐	☐	☐	☐
10. الأطفال المصابين بنزلات البرد يتماثلون للشفاء أسرع إذا عولجوا بالمضادات الحيوية	☐	☐	☐	☐	☐
11. ليس من المهم اتباع الجرعة الموصوفة بدقة تامة	☐	☐	☐	☐	☐

الرجاء وضع اشارة [X]عند الاختيار المناسب

تجربتك مع المضادات الحيوية:	أبدا	نادرا	أحيانا	غالبا	دائما
1. عند زيارتي للطبيب بسبب تعرض طفلي لنزلة برد فإني أتوقع وصفة تتضمن مضاداً حيوياً	☐	☐	☐	☐	☐
2. سبق و أن عالج المضاد الحيوي أعراض البرد عند طفلي	☐	☐	☐	☐	☐
3. سبق و أن أوقفت جرعة المضاد الحيوي عن طفلي عند تحسن حالته	☐	☐	☐	☐	☐
4. سبق و أن أوقفت جرعة المضاد الحيوي عن طفلي وفقاً لنصيحة الأهل و الأصدقاء	☐	☐	☐	☐	☐
5. أحصل على المضادات الحيوية لطفلي من الصيدلية بدون وصفة طبية	☐	☐	☐	☐	☐
6. أقوم بتخزين المضادات الحيوية في المنزل في حالة احتجتها لاحقاً	☐	☐	☐	☐	☐
7. سبق و أعطيت طفلي جرعة المضاد الحيوي بدون وصفة طبية حين لاحظت ارتفاع درجة حرارة جسمه لعدة أيام	☐	☐	☐	☐	☐
8. سبق و غيرت طبيب طفلي حين لم يكتب لنا الطبيب الأول وصفة طبية بمضاد حيوي	☐	☐	☐	☐	☐

هل لديك تعليق إضافي يتعلق باستخدام المضادات الحيوية؟

.....

.....

شكرا لاكمال الاستبيان. لقد ساعدت في دعم تطوير صحة الأطفال في المملكة العربية السعودية.

الرجاء وضع الاستبيان بعد تعبئته في الصناديق المخصصة. شكراً لتعاونكم.

اذا كان لديك اي استفسار او ملاحظات الرجاء الاتصال على الرقم (+966596845783) او مراسلتي عبر البريد الالكتروني Arwa.alumran@gmail.com.

تحياتي، أروى العمران

Appendix B – The English version of the PAPA instrument

Dear parent,

My Name is Arwa Alumran, a Saudi PhD student in Australia. The aim of my research is to investigate the use of antibiotics in Saudi Arabia. If you have one or more child(ren) between the age of 1 month and 12 years, you are invited to participate in the study.

If you decide to participate, please complete this questionnaire. It includes some background information and questions about antibiotics use. It should take you about 15 minutes to complete this survey. It is important that you answer all of the questions.

All your responses will remain anonymous. Your name should not appear anywhere on the questionnaire. The information you give here will be treated in strict confidence.

Submitting the survey indicates that you have read and understood the information provided, and that you willingly agree to participate.

Thank you for your cooperation and support of our study.

Sincerely,

Arwa Alumran, MPH

General Information

1. Who is completing the questionnaire?

☐ Mother ☐ Father

☐ Legal Guardian / Other ***Please specify:**

- Relationship to child: ……..., and
- Gender: ……

2. How many children under the age of 12 years old are there in your family? ……

3. Please state your children's ages (in years) and genders

(You may use months instead of years if the child was less than one year old)

Child	Age (Years)	Gender
1		Male / Female
2		Male / Female
3		Male / Female
4		Male / Female
5		Male / Female
More		

4. Is either one of the parents/guardian trained in medical, nursing or paramedical fields?

☐ No ☐ Yes *Please specify: ……..

5. What is your age (in years)? ……

6. What is your Employment status?

☐ Unemployed ☐ Employed *Please specify……..

☐ Student ☐ Housewife ☐ Self-employed ☐ Retired

7. Level of education *(Please state the highest level of education obtained)*

☐ No formal education ☐ Junior high school ☐ High school

☐ Diploma or bachelor degree ☐ Higher degrees (i.e. post graduate, Masters, PhD)

8. What is your Geographical background? *(Where do you originally come from?)*

☐ East ☐ East ☐ Central

☐ North ☐ North

9. What is the household's monthly income?

☐ < 4,000 SAR/month ☐4,000 – 11,999 SAR/ month

☐12,000 – 21,999 SAR/month ☐22,000 – 34,999 SAR/ month ☐> 35,000 SAR/ month

Your Children's Health

Please complete these questions about your YOUNGEST child's History

1. In the past year, how often has your youngest child had a common cold?

   ☐ Never ☐ Once a year ☐ 2-3 times a year

   ☐ 4-6 times a year ☐ More than 6 times a year

2. In the past year, how often did your youngest child receive an antibiotic?

   ☐ Never ☐ Once a year ☐ 2-3 times a year

   ☐ 4-6 times a year ☐ More than 6 times a year

Please complete these questions about ANY OF YOUR CHILDREN (less than 12 years old)

3. Have any of your children (less than 12 years old) ever experienced a serious infectious disease in the past?

   ☐ Yes *Please specify: ……

   ☐ No

4. Do any of your children (less than 12 years old) have a chronic illness?

   ☐ Yes *Please specify: ……

   ☐ No

Please choose [X] the box that is most appropriate for each statement shown below.

Antibiotics and Health Information	**Strongly disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly agree**
1. Antibiotics are needed for: the common cold	☐	☐	☐	☐	☐
2. Antibiotics are needed for: Sore throat	☐	☐	☐	☐	☐
3. Antibiotics treat bacterial infections	☐	☐	☐	☐	☐
4. Antibiotics treat viral infections	☐	☐	☐	☐	☐
5. Antibiotics can cure **ALL** types of infections (viral, bacterial, & fungal)	☐	☐	☐	☐	☐
6. Antibiotics are helpful in treating common cold among children	☐	☐	☐	☐	☐
7. Antibiotics can be harmful to one's health	☐	☐	☐	☐	☐
8. Some germs are becoming harder to treat with antibiotics	☐	☐	☐	☐	☐
9. Some germs can become resistant to antibiotics if they are taken in inadequate doses	☐	☐	☐	☐	☐
10. I get my health-related information from the pharmacist	☐	☐	☐	☐	☐
11. I get my health-related information from nurses and/or other allied health professionals	☐	☐	☐	☐	☐
12. I get my health-related information from books and/or scientific literature	☐	☐	☐	☐	☐
13. I get my health-related information from family and/or friends	☐	☐	☐	☐	☐
14. I get my health-related information from the internet	☐	☐	☐	☐	☐
15. I get my health-related information from the media: TV, Radio, newspapers	☐	☐	☐	☐	☐
16. I get my health-related information from my previous experience	☐	☐	☐	☐	☐

Experience with antibiotics and health professionals	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
1. If my child gets better I can reduce the dose of antibiotics	☐	☐	☐	☐	☐
2. If my child's condition is mild I would give the antibiotic according what I see is suitable for to his/her condition	☐	☐	☐	☐	☐
3. Skipping one or two antibiotic doses doesn't make much difference	☐	☐	☐	☐	☐
4. My child will be sick for a longer time if he/she doesn't receive an antibiotic for cough, cold, or flu symptoms.	☐	☐	☐	☐	☐
5. If my child has a cold or cough it is best to get an antibiotic to get rid of it	☐	☐	☐	☐	☐
6. Children with common cold get better faster when antibiotics are given	☐	☐	☐	☐	☐
7. It is not important to follow antibiotics doses strictly	☐	☐	☐	☐	☐

Personal attitudes and beliefs about antibiotics	Never	Rarely	Sometimes	Often	Always
1. When I visit the doctor for my child's common cold I expect prescription for medication including antibiotics	☐	☐	☐	☐	☐
2. In the past, Antibiotics have cured my child's cold symptoms	☐	☐	☐	☐	☐
3. In the past, I have stopped giving my child an antibiotic because he/she felt better	☐	☐	☐	☐	☐
4. In the past, I have stopped giving my child an antibiotic because my friends/family advised me to	☐	☐	☐	☐	☐
5. I get my child's antibiotics from the pharmacy without a prescription	☐	☐	☐	☐	☐
6. I generally store antibiotics at home for when they are needed	☐	☐	☐	☐	☐
7. In the past, I have given my child an antibiotic without a prescription when he/she had a high temperature for a few days	☐	☐	☐	☐	☐
8. In the past, I have changed doctors when my doctor did not prescribe antibiotics for my child	☐	☐	☐	☐	☐

Any additional comments related to antibiotics use:

……..

……..

……..

Thank you for completing the survey. You are helping to better support children's health.

Appendix C – Pictures from the data collection

Appendix D – Means of PAPA scales in comparison with the parental usage of antibiotics in children